RESTRICTED

Serial No.

PRELIMINARY

INSTRUCTION BOOK

for

Model ARD-2
Aircraft Radio Receiving Equipment

Manufactured For

U. S. NAVY DEPARTMENT BUREAU OF SHIPS

By

MIDWEST RADIO CORPORATION
CINCINNATI, OHIO

Contract NXss-12756 Date of Contract: L.O.I. 12 June 1943

ERRATA-MODEL ARD-2 PRELIMINARY INSTRUCTION BOOK

Page 39

Add letter "C" under solid line drawing of E-102 in the illustration and add "D" under dotted outline of E-102.

Page 44

The figures entered are to illustrate the text on page 36. They were taken from an experimental set of curves and are about 15 mc. different from the curves on page 37.

Page 51 and in the envelope on inside back cover of book.

The suppressor of V-201 is grounded, not tied to cathode as shown. J-203 is a two circuit jack, not three as shown. R-224 is a $\frac{1}{2}$ watt resistor, not 1 watt as indicated in the part list.

TABLE II

Page 64, Line 13 from bottom-4S53 in Midwest Part Number column should be 4S72.

Page 66, Line 3 under INDUCTORS-"silver plated" should be "tinned."

Page 68, Line 11 from bottom-Remove Navy Type Number-631631.
Line 10 from bottom-Change "shaft 1" long" to"shaft $\frac{3}{4}$" long."

TABLE III

Page 73, Line 18 from top-Remove Navy Type Number-631631.

TABLE IV

Page 74, Line 1 from top-change Equipment Spares Quantity from "2" to "1".

Page 76, Line 5 from bottom-Add note at bottom page refering to Equipment Spares Quantity "2": *Assembled to $7\frac{1}{2}$ feet of W-501.

Page 78, Line 21 from top-Remove Navy Type Number-631631.
Line 22 from top-Change "shaft 1" long" to "shaft $\frac{3}{4}$" long".

10-11-43

RESTRICTED

PRELIMINARY

INSTRUCTION BOOK

FOR

MODEL ARD-2

AIRCRAFT RADIO RECEIVING EQUIPMENT

This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act (U. S. C. 50: 31,32). The transmission of this document or the revelation of its contents in any manner to any unauthorized person is prohibited.

This instruction book is furnished for the information of commissioned, warrant, enlisted and civilian personnel of the Navy and persons authorized by the Bureau of Ships whose duties involve design, manufacture, instruction, operation and installation of radio, radar, or underwater sound equipment. The word "Restricted" as applied to this instruction book, signifies that this instruction book is to be read only by the above personnel, and that its contents should not be made known to unauthorized persons not connected with the Navy.

Manufactured for

U. S. NAVY DEPARTMENT BUREAU OF SHIPS

BY

MIDWEST RADIO CORPORATION

CINCINNATI, OHIO

Contract NXss-12756 Date of Contract: L.O.I. 12 June 1943

"THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF SHIPS MANUAL OF ENGINEERING INSTRUCTION, CHAPTER 31 (MIMEOGRAPHED FORM) OR SUBSEQUENT REVISION THEREOF ON THE SUBJECT OF 'RADIO-SAFETY PRECAUTIONS TO BE OBSERVED'."

GUARANTEE

The equipment, including all parts and spare parts, except vacuum tubes, shall be guaranteed for a service period of one year with the understanding that, as a condition of this contract, all items found to be defective as to design, material, workmanship or manufacture shall be replaced without delay and at no expense to the Government, provided that such guarantee and agreement shall not obligate the contractor to make replacement of defective material unless the failure, exclusive of normal shelf life deterioration, occurs within a period of two years from the date of delivery of the equipment to and acceptance by the Government, and provided further, that if any part or parts (except vacuum tubes) fail in service or are found defective in ten per cent (10 per cent) or more, but not less than two, of the total number of equipments furnished under the contract, such part or parts, whether supplied in the equipment or as spares, shall be conclusively presumed to be of defective design, and as a condition of contract subject to one hundred per cent (100%) replacement of all similar units supplied on subject contract by suitable redesigned replacements. Failure due to poor workmanship while not necessarily indicating poor design, will be considered in the same category as failure due to poor design. Redesigned replacements which will assure proper operation of the equipment shall be supplied promptly, transportation paid, to the Naval activities using such equipment, upon receipt of proper notice and without cost to the Government. All defective parts originally furnished under contract shall be held subject to rejection and return to the contractor.

This period of two years and the service period of one year shall not include any portion of the time that the equipment fails to give satisfactory performance due to defective items and the necessity for replacement thereof, and provided further, that any replacement part shall be guaranteed to give one year of satisfactory service.

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 31 (Mimeographed form) of the Manual of Engineering Instructions, or Bureau of Ships Radio and Sound Bulletin number 7, dated July 1, 1942, or superseding instructions.

Pertinent dates affecting replacements under the guarantee shall be filled in at time of installation by Navy personnel.

Contract no. NXss-12756 Date of contract extension June 12, 1943

Serial number of equipment _____

Date of acceptance by the Navy _____

Date of delivery to contract destination _____

Date of completion of installation _____

Date placed in service _____

All request or requisitions for replacement material should include complete descriptive data covering the part desired, in the following form:

1. Name of part desired.
2. Navy Type number (if assigned) (including prefix and suffix as applicable).
3. Model designation (including suffix) of equipment in which used.
4. Navy Type designation (including prefix and suffix where applicable) of major unit in which part is used.
5. Symbol designation of part.
6. (a) Navy Drawing Number.
   (b) Manufacturer's Drawing Number.
7. Rating or other descriptive data.
8. Commercial designation.

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I GENERAL DESCRIPTION

The model ARD-2 equipment is a non-radiating intercept receiver primarily intended for airborne use. It is designed to detect radar signals beyond the effective range of the radar, to measure carrier frequencies from 80 to 3000 megacycles and pulse repetition rates from 50 to 8000 cycles per second. Approximate location of radar transmitters may also be determined when the directive properties of a given ARD-2 antenna installation are known.[1] The equipment consists of a tunable antenna-detector unit, an amplifier and power supply on one chassis, and a test oscillator.

The antenna should be mounted at an angle of forty-five degrees in order to receive either vertically or horizontally polarized radar transmissions. A minimum signal of from five to ten millivolts is required, depending upon the noise level of a given installation. However, signals can be heard at two or three times the range of a radar system because of the relatively high losses sustained in reradiation from the target and the distance traversed by the echo which the more sensitive radar receiver must overcome.

1. See procedure for calibrating the ARD-2 antenna installation. pp. 40-42.

Power Supply Characteristics Suitable for Operation on 115/1/60-2400				
Major Units		Weight in pounds	Number of operating tubes used	Navy type designation
Type Number	Title			
CMD-66 AFH	Antenna & Detector	4.8	1	-446A
CMD-50 ADC	Amplifier	23.75	3	-6AC7
			2	-6SN7GT
			1	-6E5
			1	-6SL7GT
			1	-5Y3GT
			1	-VR150-30
CMD-60ABG-1	Test Oscillator	3.3	1	-955
			1	-6SL7GT
CMD-10229	Shock Mount	3.93	none	
	Accessories	5.53	none	
	Equipment spares	---	200%	
	Stock spares	---	none	

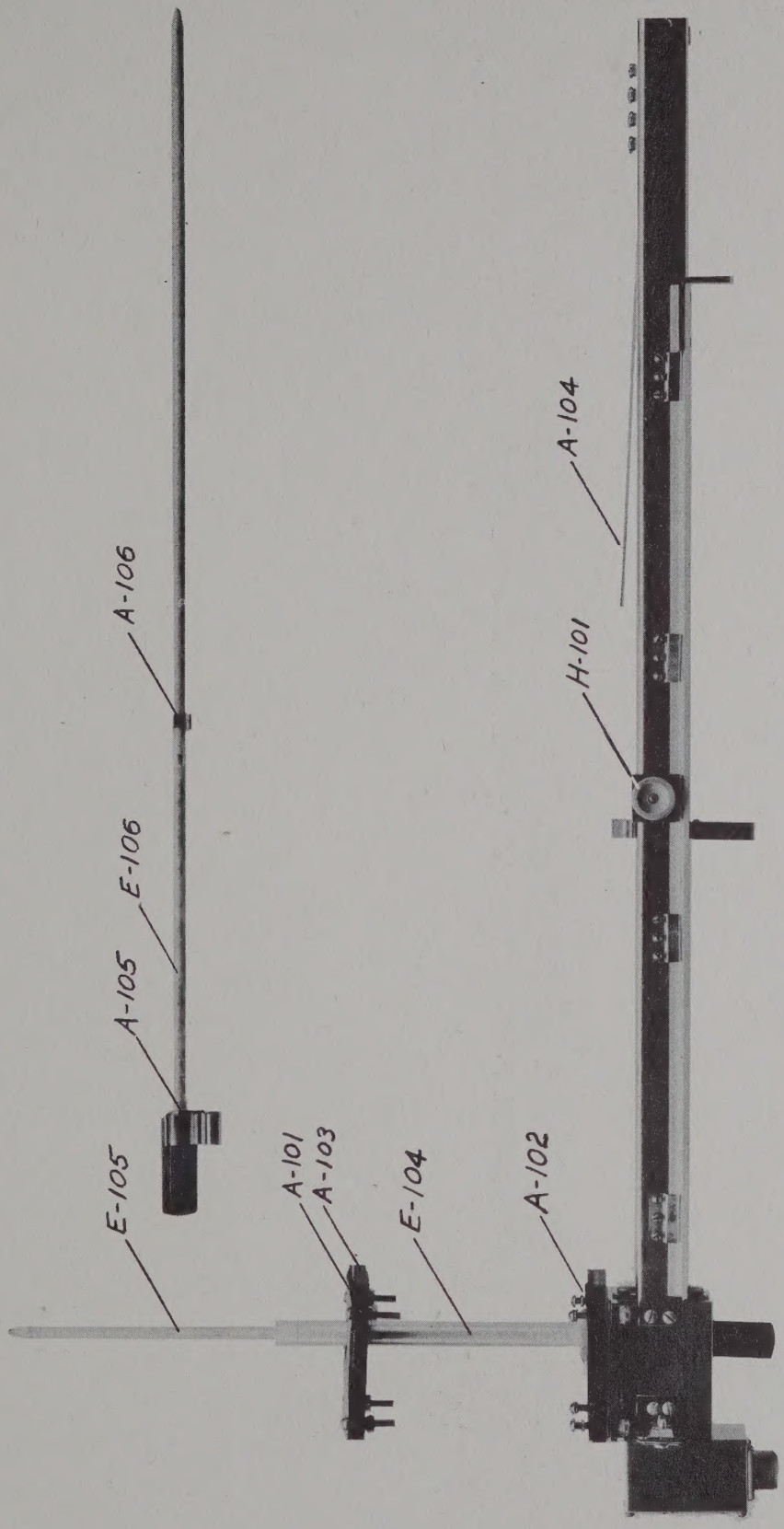


Figure 1

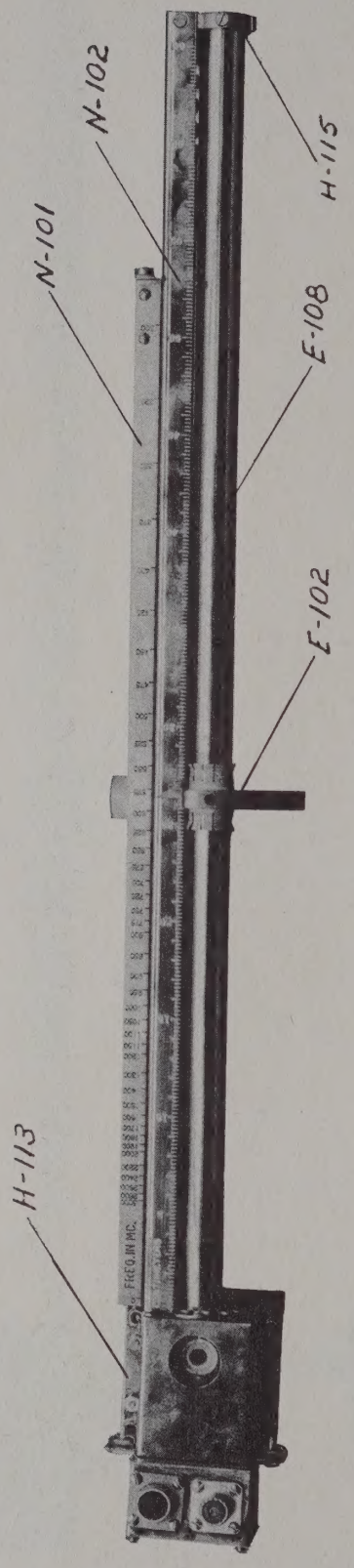


Figure 2

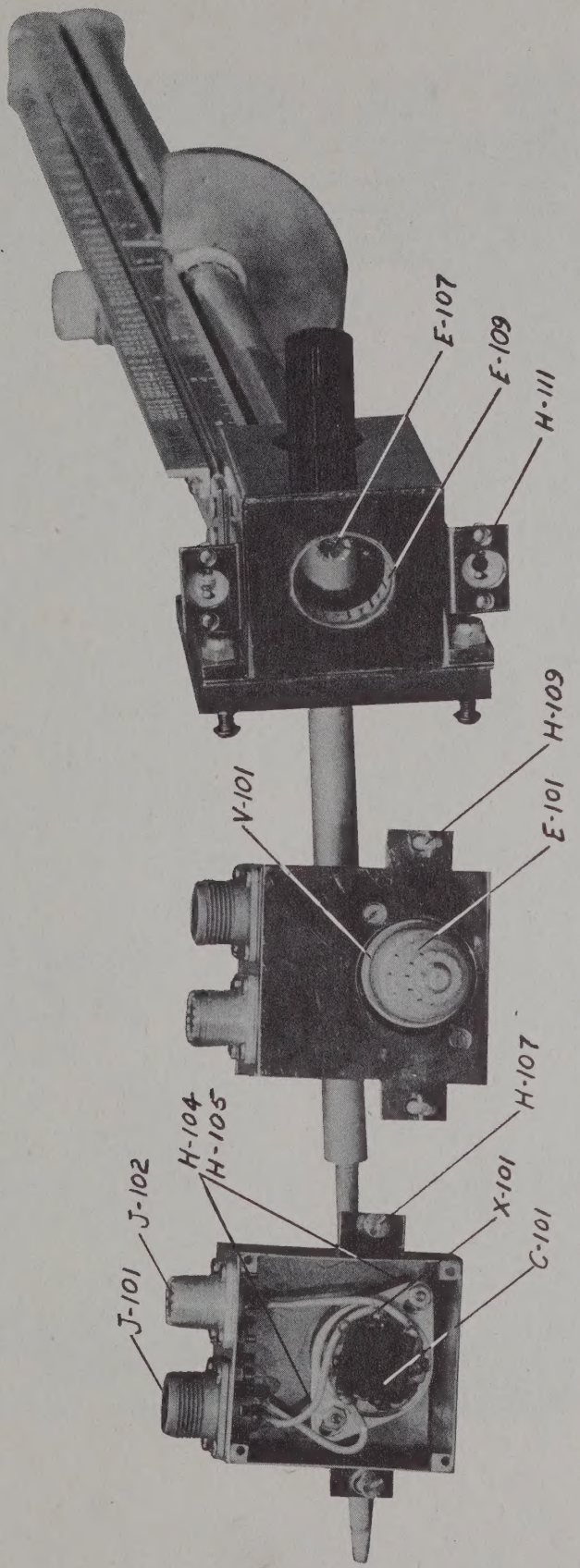

E-107
E-109
H-111
H-109
E-101
V-101
H-107
X-101
C-101
H-104
H-105
J-102
J-101

Figure 3

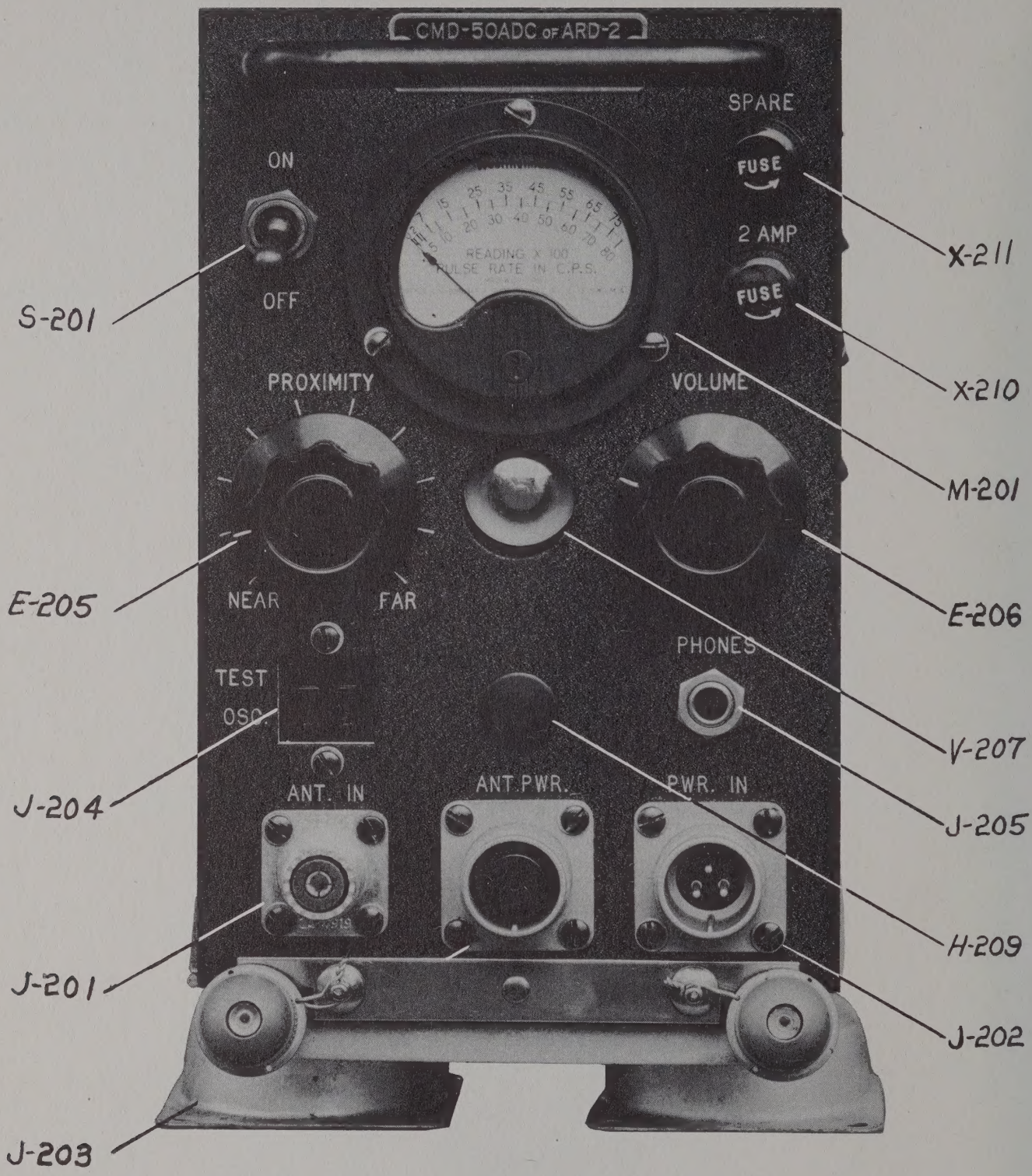

CMD-50ADC or ARD-2
SPARE
FUSE
2 AMP
FUSE
ON
OFF
READING X 100
PULSE RATE IN C.P.S.
PROXIMITY
VOLUME
NEAR
FAR
PHONES
TEST
OSC.
ANT. IN
ANT. PWR.
PWR. IN
S-201
X-211
X-210
M-201
E-205
E-206
V-207
J-204
J-205
J-201
H-209
J-202
J-203

Figure 4

II DESCRIPTION OF MAJOR UNITS

ANTENNA-DETECTOR, TYPE CMD-66 AFH

This unit is composed of (1) an antenna which may be changed to provide three lengths, E-104, E-105, or E-106; (2) a diode detector, V-101; and (3) a tuning stub, E-108. Tuning is accomplished by sliding the shorting bar, E-102, along the stub, E-108.[2]

The sharpness of tuning for a given antenna length varies with frequency. Three antenna lengths are required because tuning becomes very broad at frequencies approaching the natural resonance of the ARD-2 antenna. The width of the region over which a signal may be found along the tuning stub also depends upon the setting of the "Proximity" (gain) control, E-205, on the amplifier unit.

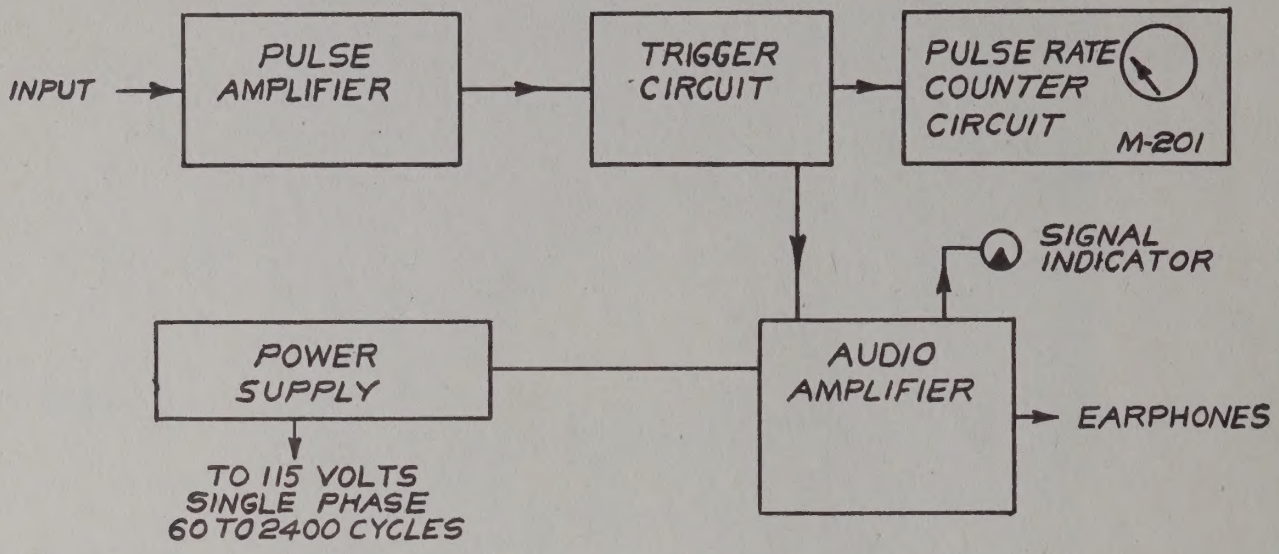
A calibration curve is required for determining the carrier frequency of signals which come in only once along the tuning stub.[3] Signals above 300 megacycles may be found at two or more places one half wave apart. A sliding scale, N-101, calibrated in megacycles is provided for measuring carrier frequency directly whenever two tuning points may be found.[4]

AMPLIFIER, TYPE CMD-50 ADC

The amplifier is mounted on a standard "half" ATR rack. This unit contains a three stage pulse amplifier, a trigger

2. See photograph of antenna-detector unit. Figs. 1-3, pp. 11-13.
3. See detector calibration curve. Fig. 18, p. 37.
4. See procedure for determining carrier frequency pp. 36-39.

circuit, a pulse rate counter circuit, an audio amplifier, a visual signal indicator, and a rectifier power supply.



AMPLIFIER BLOCK DIAGRAM

Pulse Amplifier

The pulse amplifier employs three 6AC7 tubes, V-201, V-202, and V-203. Output from the detector is coupled to the grid of V-201 through a transformer, T-201. Resistance capacity coupling is used between the amplifier stages. The pulse amplifier has an overall band pass from 30 kilocycles to 130 kilocycles at half energy points. The last stage, V-203, is adjusted to limit the amplitude of the pulse input to the trigger circuit.

Trigger Circuit

A 6SL7GT tube, V-204, is used in the trigger circuit to convert pulses from the pulse amplifier into square waves of constant amplitude for the pulse rate counter and audio amplifier.

Pulse Rate Counter Circuit

This circuit requires a 6SN7GT tube, V-206. Square wave

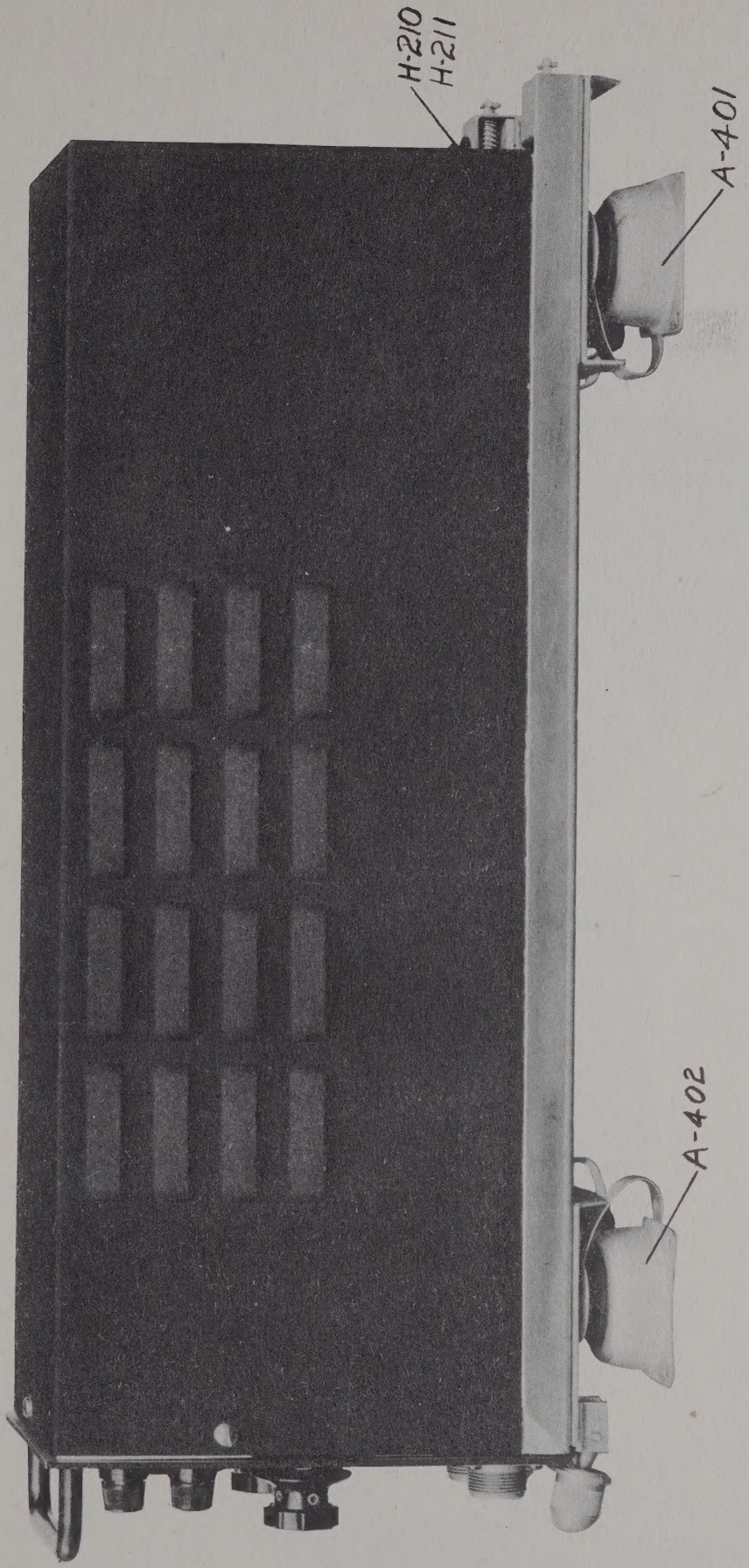


Figure 5

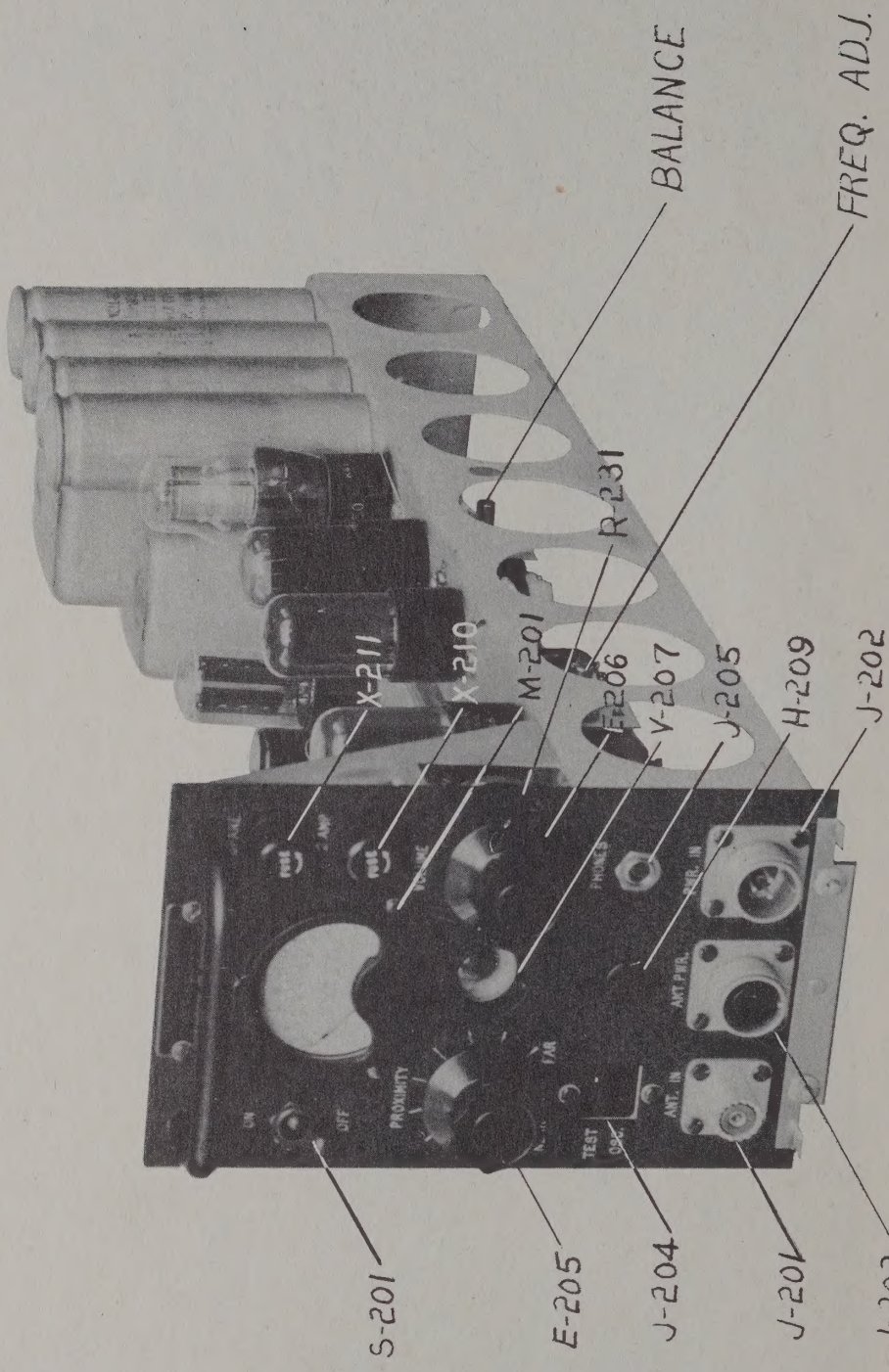

BALANCE
FREQ. ADJ.
R-231
M-201
X-211
X-210
V-207
J-205
H-209
J-202
S-201
E-205
J-204
J-201
J-203

Figure 6

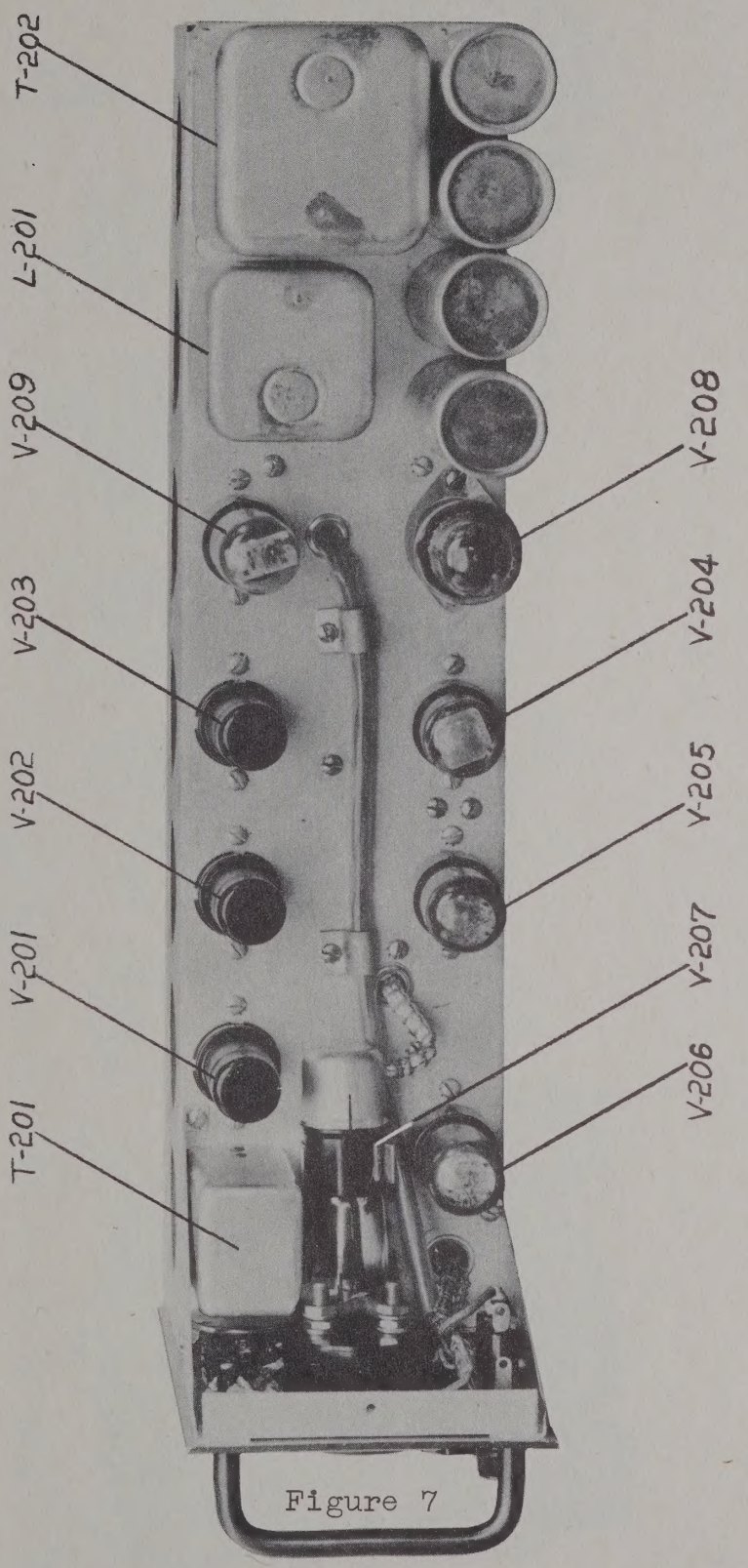


Figure 7

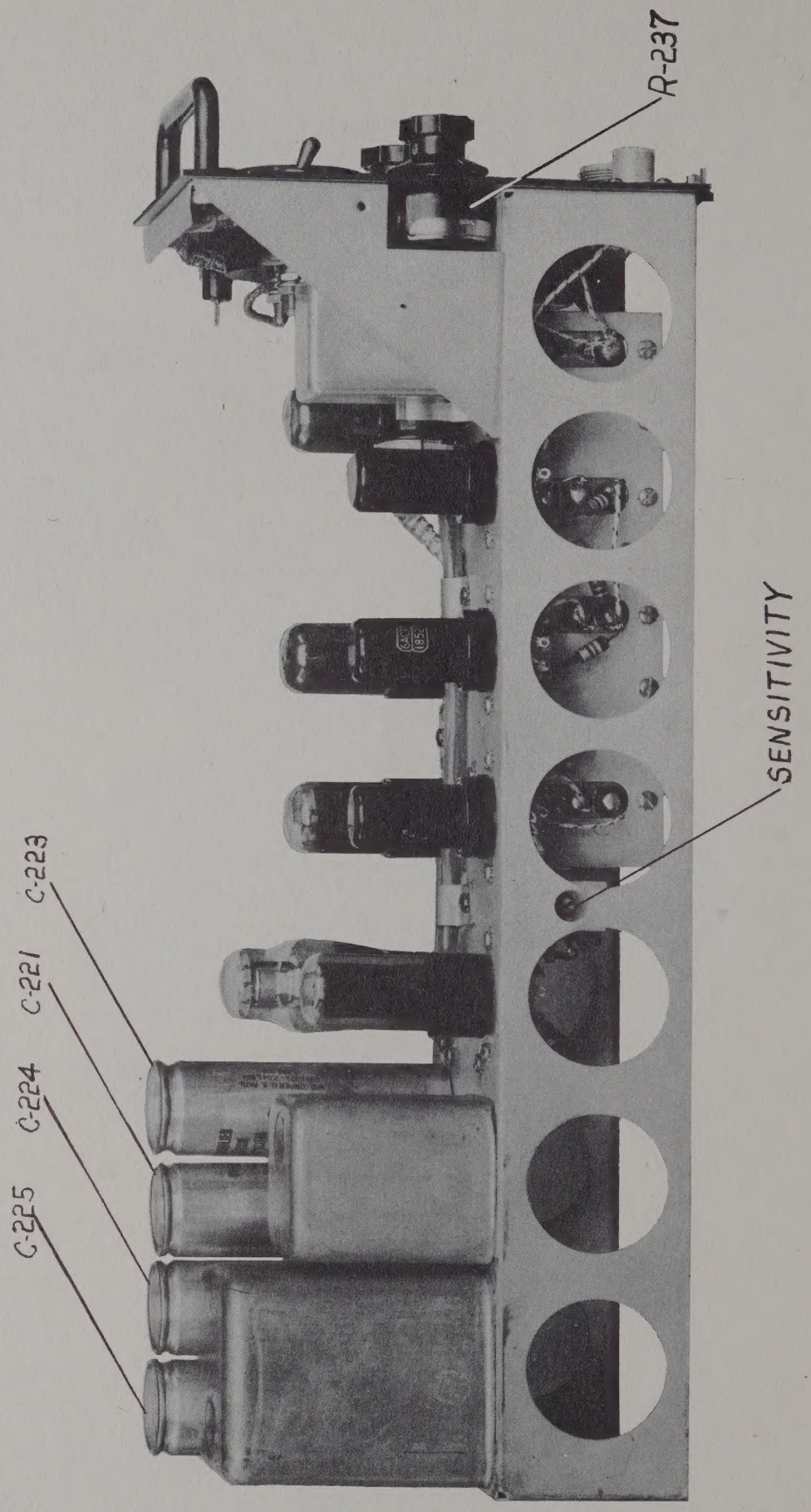


Figure 8

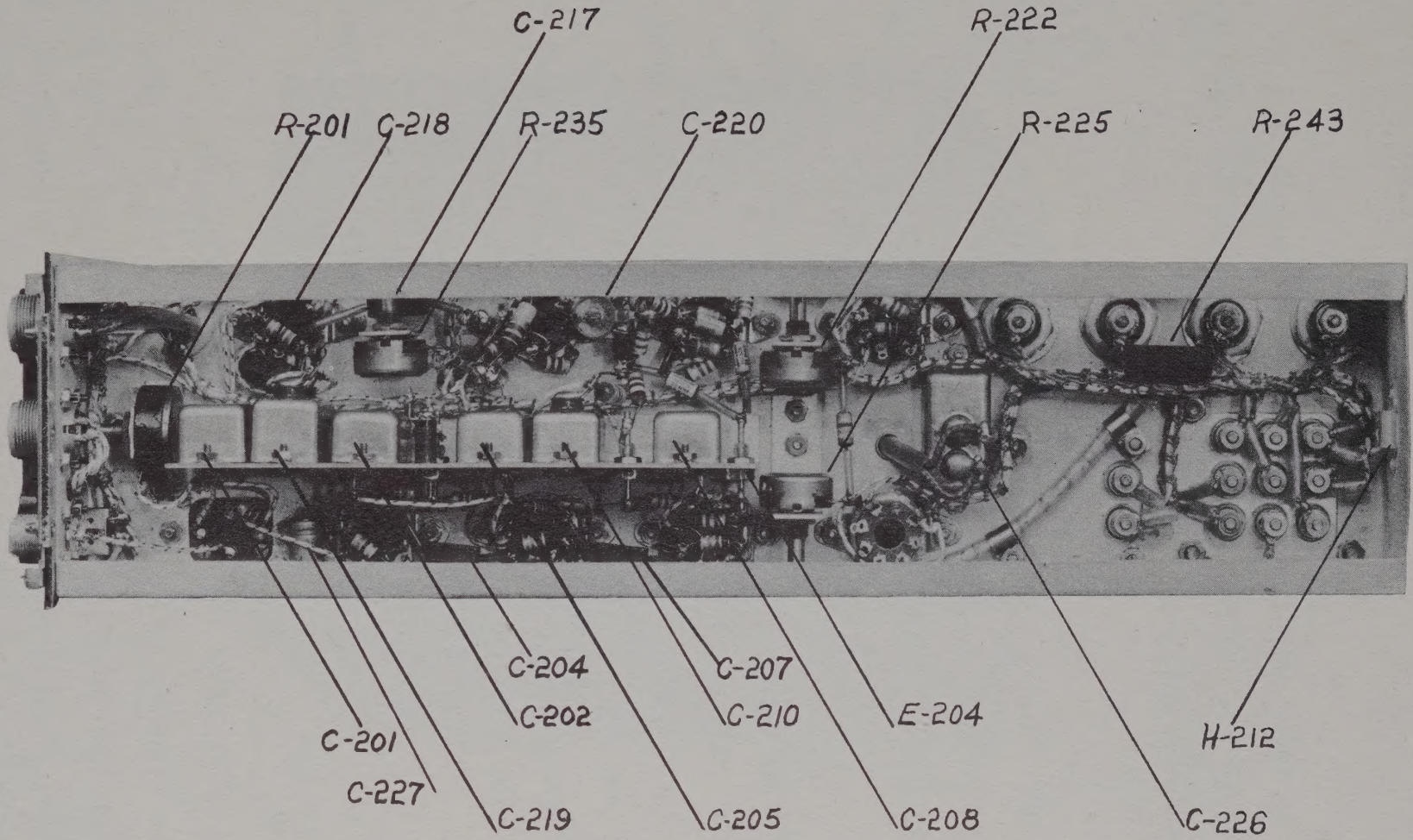

C-217
R-222
R-201
C-218
R-235
C-220
R-225
R-243
C-204
C-207
C-202
C-210
E-204
H-212
C-201
C-227
C-219
C-205
C-208
C-226

Figure 9

output from the trigger circuit is differentiated and the resulting pulses are integrated to operate the meter, M-201.

Audio Amplifier

The audio amplifier uses a 6SN7GT tube, V-205, It is composed of one stage of audio amplification and cathode follower output to a headphone jack.

Visual Signal Indicator

A 6E5 "magic eye" tube, V-207, is coupled to the audio amplifier to provide a visual signal indicator. See operational note page 43.

Power Supply

The power supply is designed to work on 115 volts single phase alternating current from 60 to 2400 cycles. It uses one 5Y3GT tube, V-209, and one VR150-30 tube, V-208. The 5Y3GT tube is connected as a full wave rectifier. The VR150-30 is required to regulate 150 volts of d.c. for the trigger and pulse rate counter circuits.

SHOCK MOUNT, TYPE CMD-10229

A standard "half" ATR rack shock mount is provided for the amplifier unit.

TEST OSCILLATOR, TYPE CMD-60ABG-1

The test oscillator has a fixed carrier frequency of approximately 400 megacycles. A 955 oscillator is pulse modulated by a 6SL7GT connected as a multivibrator. Selection of four pulse repetition rates is made by the pointer knob, E-303.

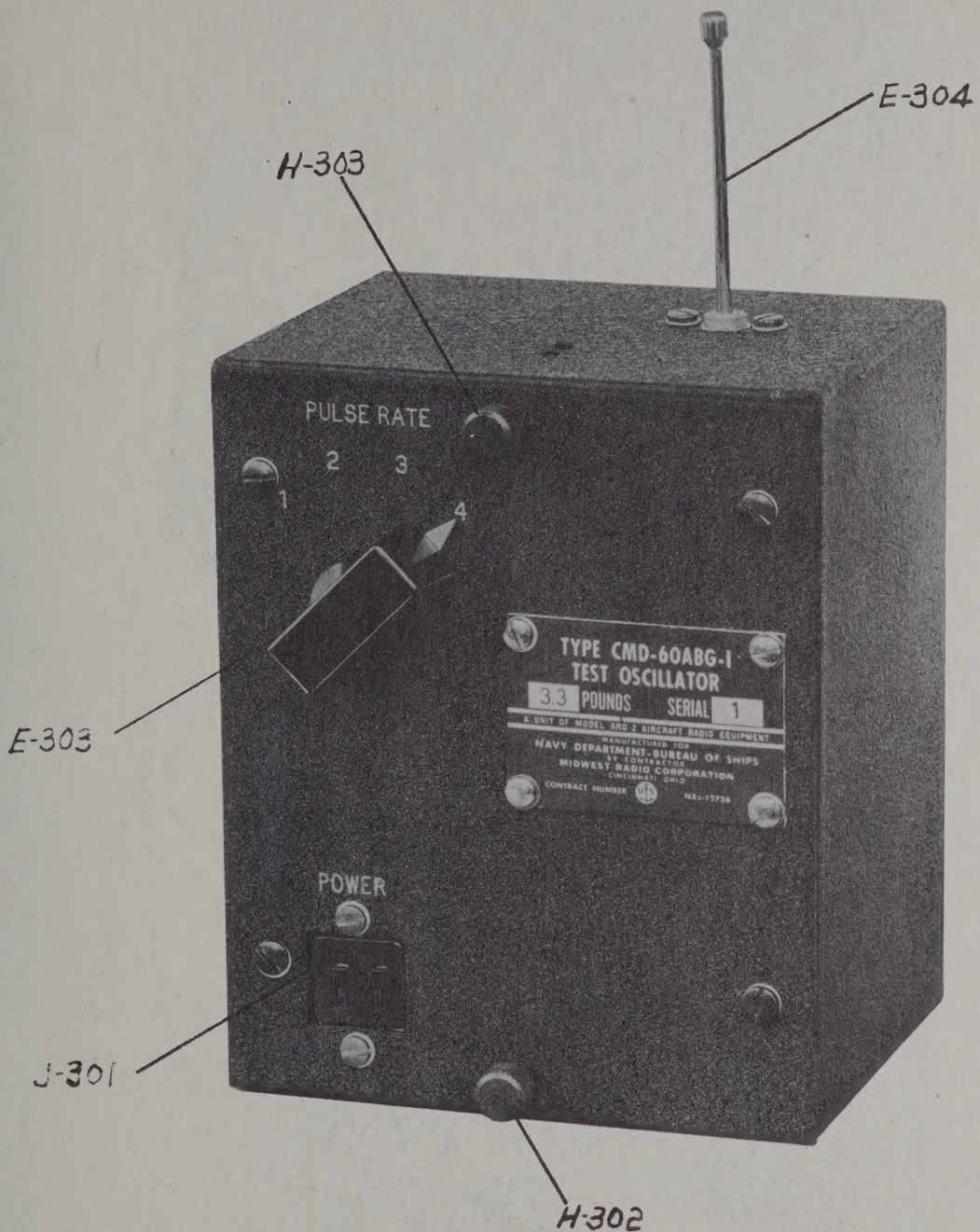

E-304
H-303
PULSE RATE
1
2
3
4
E-303
TYPE CMD-60ABG-1
TEST OSCILLATOR
3.3 POUNDS SERIAL 1
A UNIT OF MODEL ARD-2 AIRCRAFT RADIO EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT-BUREAU OF SHIPS
BY CONTRACTOR
MIDWEST RADIO CORPORATION
CINCINNATI, OHIO
CONTRACT NUMBER NXs-15756
POWER
J-301
H-302

Figure 10

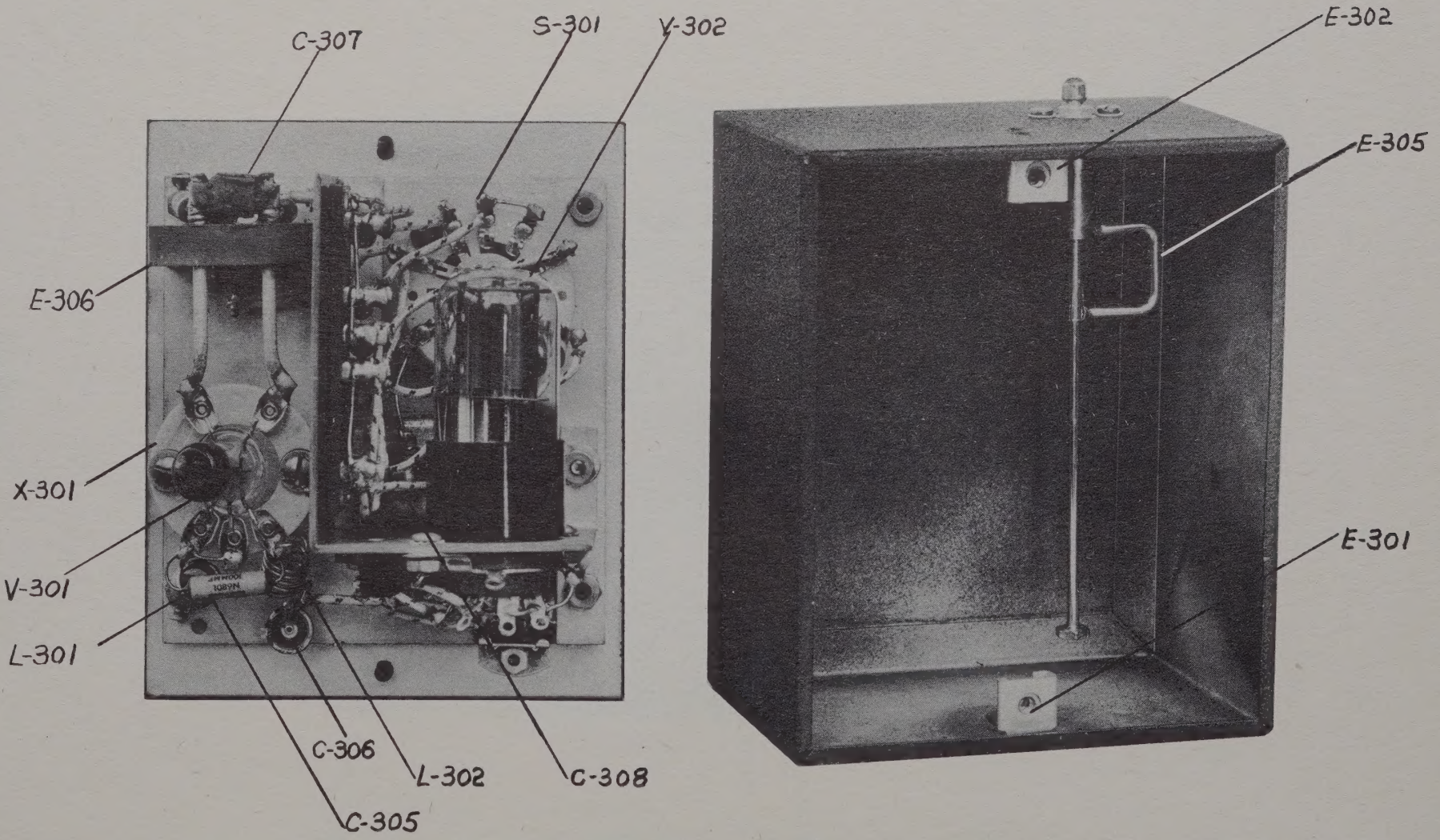

C-307
S-301
V-302
E-306
X-301
V-301
L-301
C-306
L-302
C-308
C-305
E-302
E-305
E-301

Figure 11

III INSTALLATION

Space requirements inside the plane will largely determine the location of the ARD-2 receiving equipment. Charts showing the physical dimensions, position of mounting holes, and cable requirements are included in this section. The following considerations should be observed:

1. There must be good electrical contact between the metal "skin" of the plane and the base of the ARD-2 antenna. This will require scraping paint in order to provide clean surface for the mounting bolts.

2. A metal ground sheet of at least three foot radius should be provided for the ARD-2 antenna if it is to be installed on a plastic or fabric covered plane.

3. The antenna detector unit would be bolted directly against the metal "skin" of the plane by the mounting strips, H-113, in an ideal installation. In any case, the antenna element, E-104, should protrude as much as possible and be positioned at an angle of forty-five degrees above or below the horizon when the plane is in normal flight.

4. The amplifier must be conveniently located with respect to the antenna-detector because it is necessary to tune the shorting bar, E-102, and adjust the setting of the

"Proximity" control E-205, at the same time. It is also highly desirable to be able to observe the visual signal indicator while tuning the shorting bar, E-102. See operational note, page 43.

It is important that every effort be made to minimize noise interference in order to utilize the full sensitivity of the ARD-2 receiver. In some installations it may prove best to insulate the lower end of the tuning stub, E-108. Results obtained by grounding the amplifier to all four shock mounts should be compared with a single ground, and none at all. There must be no casual metal contacts which may vibrate against the ARD equipment. Cable fittings must be secure and not rub against each other. The cables connecting the antenna-detector to the amplifier should run as far as possible from electric motor-generator equipments or other noise sources. All clamps, bolts, and screws must be kept tight. The antenna extensions, E-105, and E-106, should be cleaned frequently, particularly the tapered section which makes contact with the permanent antenna element, E-104. They must be screwed in firmly when in use.

POWER SOURCE

Power for the ARD-2 equipment must be as free as possible from high frequency harmonics and transients. Best sensitivity can be attained on 60 cycle input, but it is expected that only 800 cycle or variable frequency power sources will be available on planes. The NEA-2D 800 cycle generator gives a loss of sensitivity ranging from two to five DB. Results obtained on a model 800-1-B alternator were down 15 DB. This alternator is not recommended for the ARD-2.

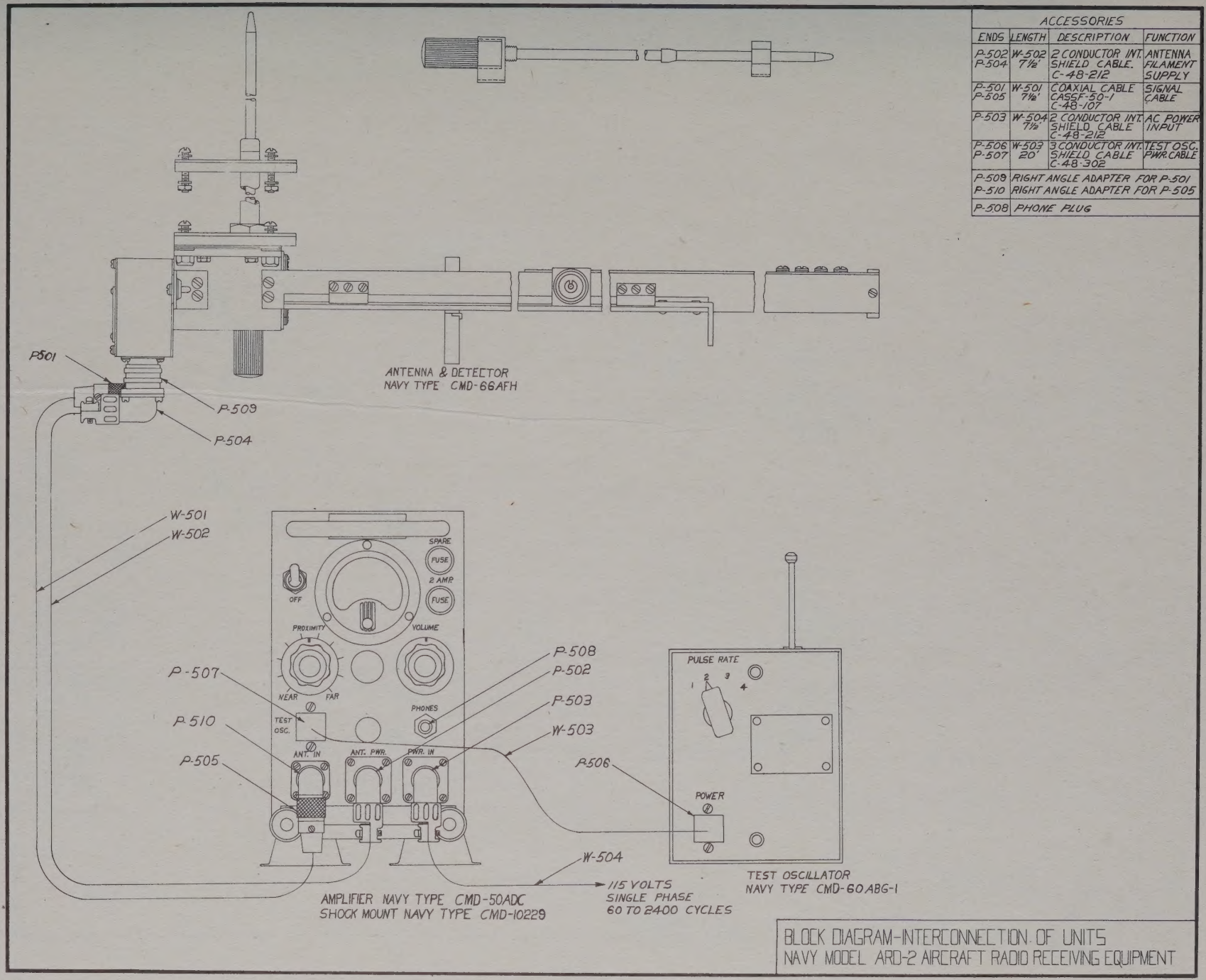

ACCESSORIES
ENDS | LENGTH | DESCRIPTION | FUNCTION
P-502 P-504 | W-502 7½' | 2 CONDUCTOR INT. SHIELD CABLE. C-48-212 | ANTENNA FILAMENT SUPPLY
P-501 P-505 | W-501 7½' | COAXIAL CABLE CASSF-59-1 C-48-107 | SIGNAL CABLE
P-503 | W-504 7½' | 2 CONDUCTOR INT. SHIELD CABLE C-48-212 | AC POWER INPUT
P-506 P-507 | W-503 20' | 3 CONDUCTOR INT. SHIELD CABLE C-48-302 | TEST OSC. PWR. CABLE
P-509 | RIGHT ANGLE ADAPTER FOR P-501
P-510 | RIGHT ANGLE ADAPTER FOR P-505
P-508 | PHONE PLUG
ANTENNA & DETECTOR
NAVY TYPE CMD-66AFH
P501
P-509
P-504
W-501
W-502
SPARE FUSE
2 AMP FUSE
OFF
PROXIMITY
VOLUME
NEAR
FAR
PHONES
TEST OSC.
ANT. IN
ANT. PWR.
PWR. IN
P-507
P-510
P-505
P-508
P-502
P-503
W-503
P-506
W-504
PULSE RATE
1 2 3 4
POWER
115 VOLTS
SINGLE PHASE
60 TO 2400 CYCLES
AMPLIFIER NAVY TYPE CMD-50ADC
SHOCK MOUNT NAVY TYPE CMD-10229
TEST OSCILLATOR
NAVY TYPE CMD-60ABG-1
BLOCK DIAGRAM-INTERCONNECTION OF UNITS
NAVY MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

Figure 12

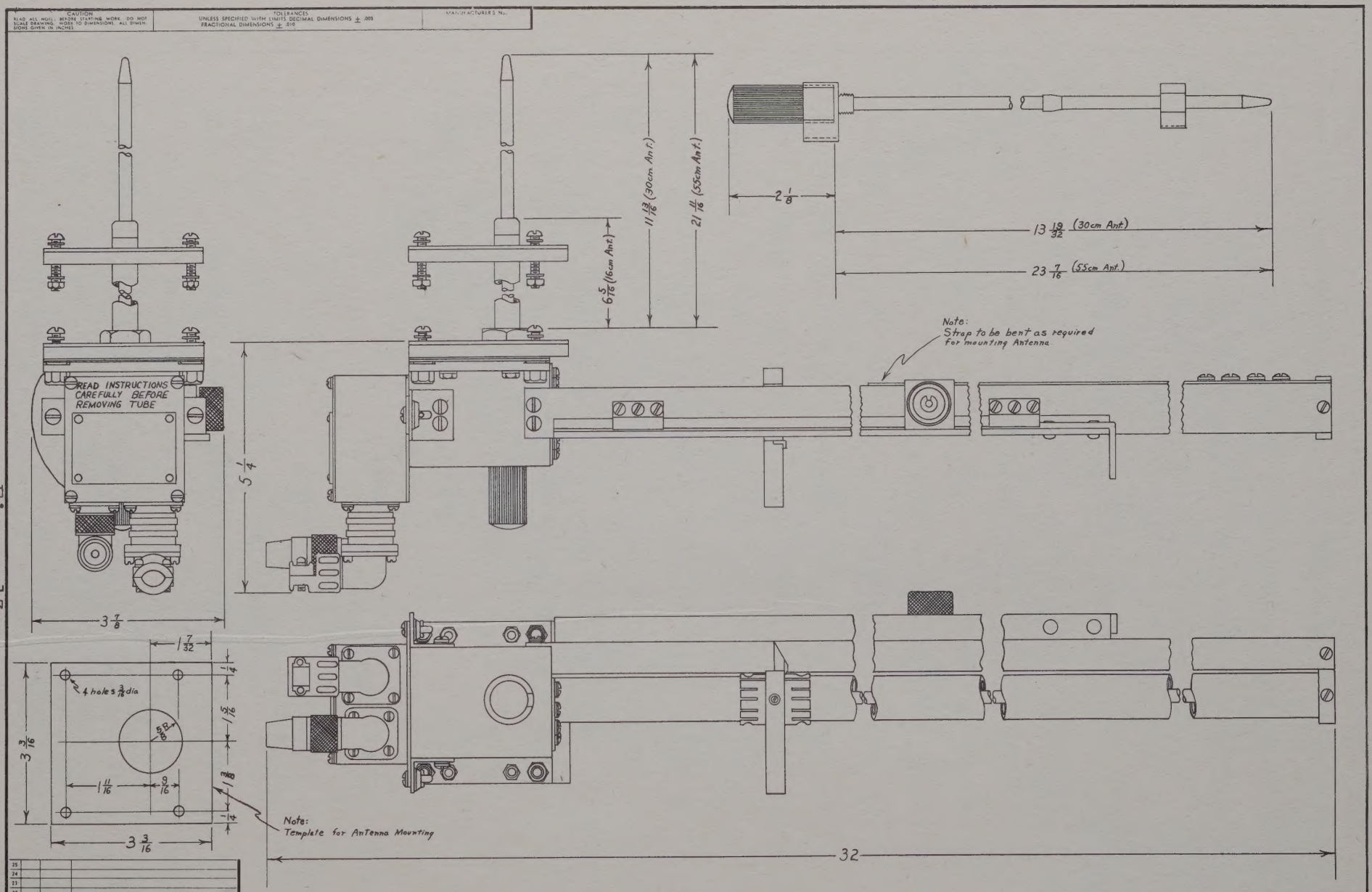

CAUTION
READ ALL NOTE BEFORE STARTING WORK. DO NOT SCALE DRAWING. WORK TO DIMENSIONS. ALL DIMENSIONS GIVEN IN INCHES
TOLERANCES
UNLESS SPECIFIED WITH LIMITS DECIMAL DIMENSIONS ± .005
FRACTIONAL DIMENSIONS ± .010
MANUFACTURER'S No.
READ INSTRUCTIONS CAREFULLY BEFORE REMOVING TUBE
6 5/16 (16cm Ant.)
11 13/16 (30cm Ant.)
21 11/16 (55cm Ant.)
2 1/8
13 19/32 (30cm Ant)
23 7/16 (55cm Ant)
Note:
Strap to be bent as required for mounting Antenna
5 1/4
3 7/8
1 7/32
4 holes 7/16 dia
5/16 R
1/4
1 5/16
3 3/16
1 11/16
9/16
1 3/16
1/4
3 3/16
Note:
Template for Antenna Mounting
32
ITEM REQ. PART No. DESCRIPTION
ITEM REQ. MFR'S No. PART No. DESCRIPTION USED ON No.
MANUFACTURER
QUANT.
MATERIAL
FINISH
TITLE ANTENNA & DETECTOR
SCALE Full
DATE 8-6-43
JOB WJ 7
DRAWN H.J.G
CHECKED WR
APPROVED
PART No. ID701
REVISION DATE APPR'D
MIDWEST RADIO CORP., 909-11 BROADWAY, CINCINNATI, OHIO

Figure 13
28

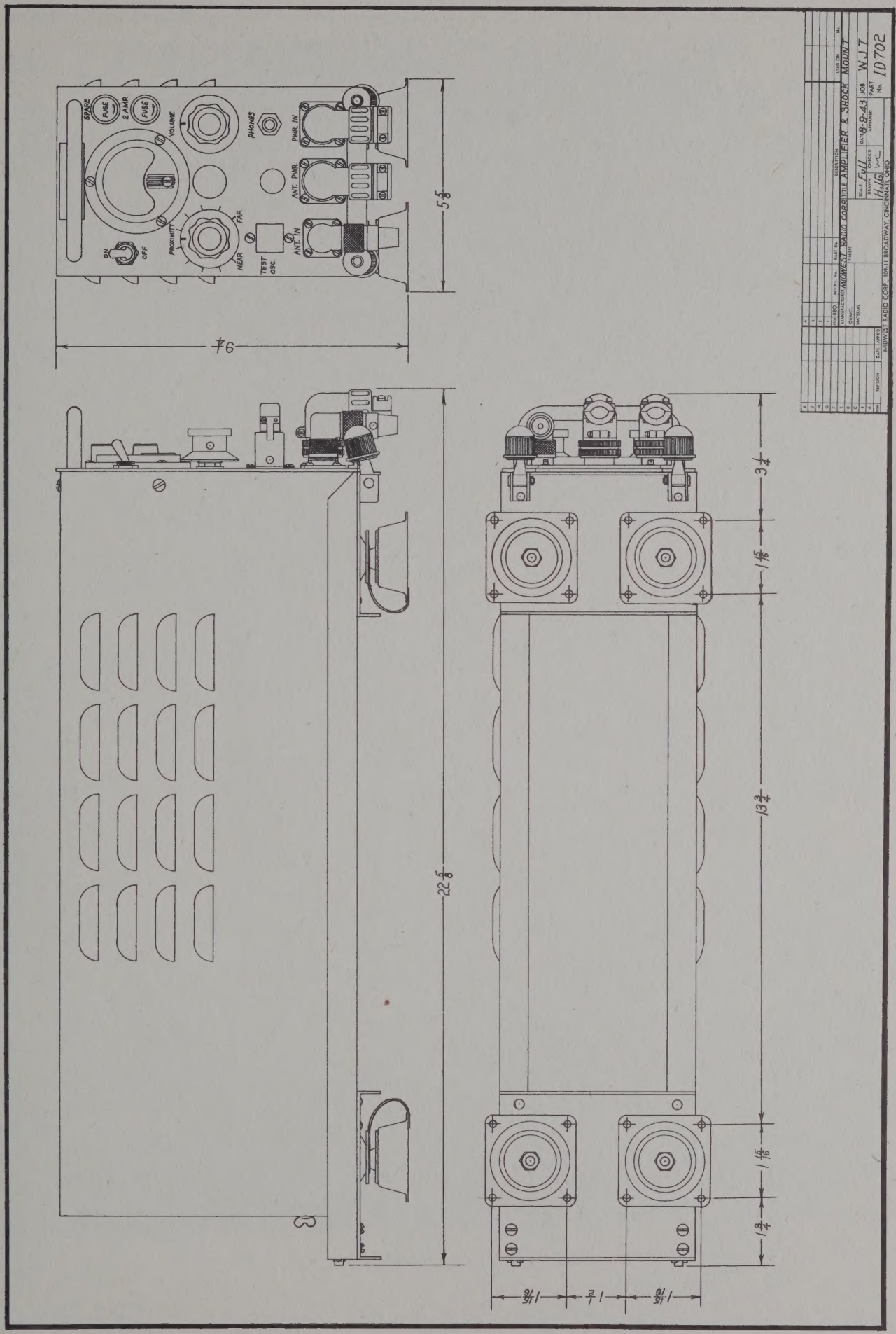

SPARE FUSE
2 AMP. FUSE
VOLUME
PHONES
PWR. IN
ANT. PWR
PROXIMITY
FAR
NEAR
TEST OSC.
ANT. IN
ON
OFF
5⅝
7⅛
22⅝
3¼
1 15/16
13¾
1 15/16
1¾
1 5/16
1 7/16
1 5/16
MIDWEST RADIO CORP. 909-11 BROADWAY CINCINNATI, OHIO
MIDWEST RADIO CORP.
AMPLIFIER & SHOCK MOUNT
8-9-43
WJT
ID702

Figure 14

CAUTION	TOLERANCES	MANUFACTURER'S No.
READ ALL NOTES BEFORE STARTING WORK. DO NOT SCALE DRAWING. WORK TO DIMENSIONS. ALL DIMENSIONS GIVEN IN INCHES.	UNLESS SPECIFIED WITH LIMITS DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± .010	

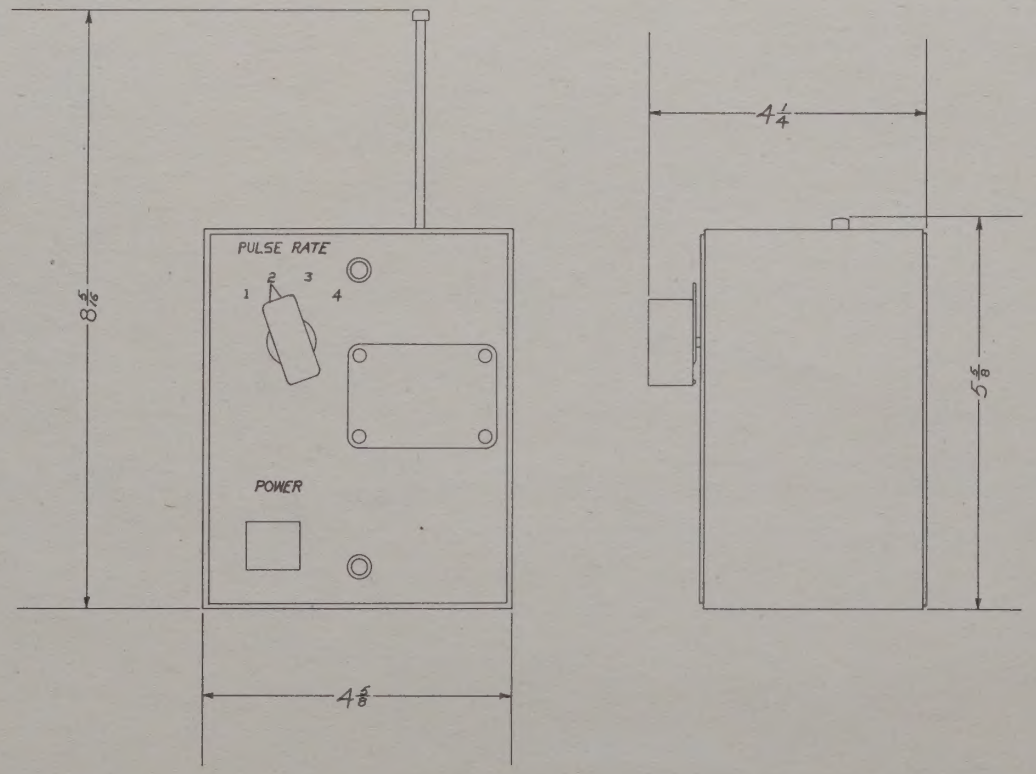


Figure 15

ITEM	REQ.	PART No.	DESCRIPTION
28			
24			
23			
22			
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20			
19			
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17			
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13			
12			
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10			
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6			
5			

ITEM	REQ.	M'FR'S. No.	PART No.	DESCRIPTION	USED ON	No.
4						
3						
2						
1						

MANUFACTURER MIDWEST RADIO CORP. TITLE TEST OSCILLATOR

QUANT. FINISH

MATERIAL

SCALE 1=1 DATE 8-28-43 JOB WJ7

DRAWN JWS CHECK'D APPROVED PART No. ID-703

ITEM	REVISION	DATE	APP'D

MIDWEST RADIO CORP., 909-11 BROADWAY, CINCINNATI, OHIO

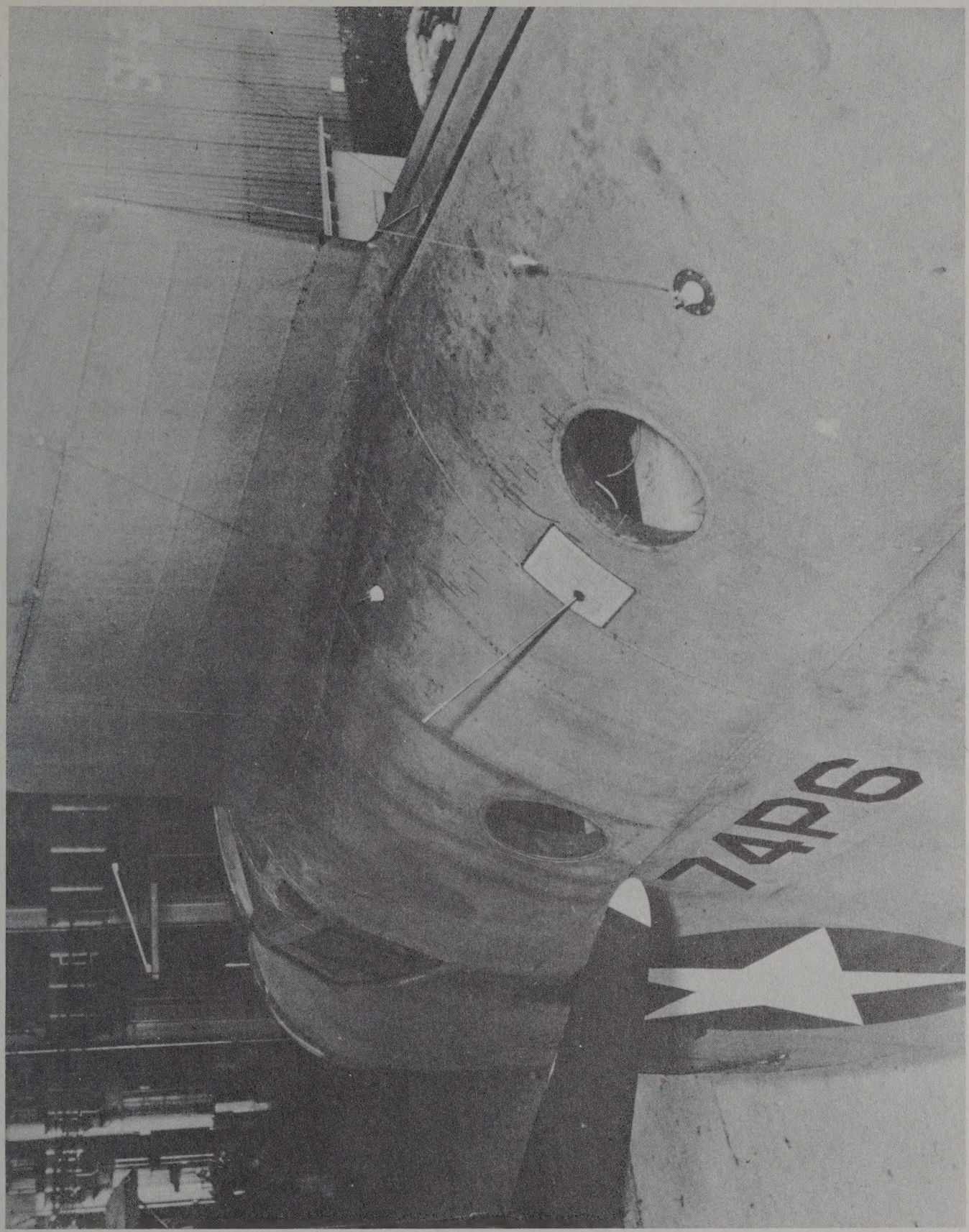


Figure 16

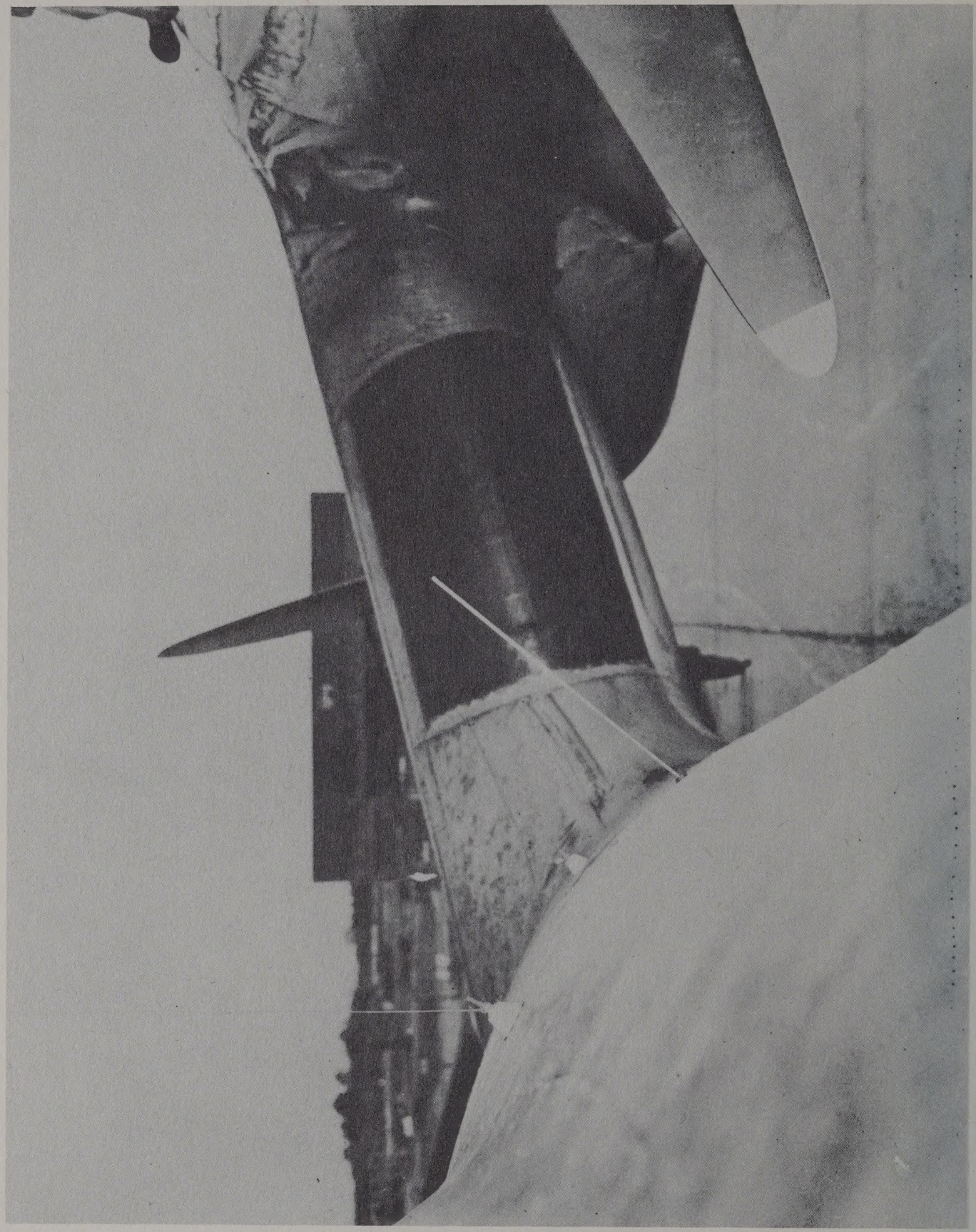


Figure 17

IV ADJUSTMENTS

The antenna-detector and test oscillator units do not require any preliminary adjustment before being put into operation.

The adjustment of the amplifier may be checked as follows: Disconnect the signal cable, W-501, from the amplifier and turn the "Proximity" control almost all of the way to the right.[5] The amplifier should then be quiet except for occasional random clicks in the headphones and a corresponding opening and closing of the visual signal indicator, V-207. The clicks are caused when the noise peaks in the pulse amplifier are of sufficient amplitude to key the trigger circuit. A sensitivity control, R-225, determines the threshold response of the trigger circuit. Oscillation is possible if this control is advanced too far. Approximately thirty degrees short of this position is considered the best setting for R-225. Noise from external sources will require reducing the pulse amplifier gain ("Proximity" control) until the amplifier is quiet. The sensitivity control, R-225, should then be reset for clear cut random clicks as detailed above. Do not disturb the position of the "Balance" control, R-222, or the "Freq. adj." control, R-235. Procedure for setting these is described under MAINTENANCE pages 48 and 49.

Adjustment of the detector bias control, R-201, requires the test oscillator. This provides an overall system check. Replace the signal cable, W-501, and connect the test oscillator, using cable W-503. Extend the test oscillator antenna, E-304. The

5. The position of the "Proximity" control for maximum gain may be determined by listening. Usually this will be found between six and eight divisions on the dial.

test oscillator may be located a convenient distance from the ARD-2 antenna-detector, but both antennae should be approximately parallel. Pulse rate position number 2 is recommended for this adjustment. Tune the antenna-detector unit by moving the shorting bar, E-102, until the signal from the test oscillator can be heard.[6] The setting of the "Proximity" control must then be reduced until the signal fails to key the trigger circuit cleanly. Adjustment of the detector bias control, R-201, should restore the clean note in the phones. R-201 is located behind the plug button, H-209, and may be reached through the amplifier front panel. This adjustment should be repeated until the peak setting for R-201 is found. An occasional -446 detector tube will not show any improvement in sensitivity when R-201 is adjusted.

6. The position of the test oscillator may need to be shifted slightly if no signal is found.

V OPERATION

The entire equipment is turned on by the toggle switch, S-201. Gain in the pulse amplifier is adjusted by turning the "Proximity" control, E-205. This control is a proximity control only in the sense that variations in signal strength may be observed by noting the settings required to key the trigger circuit. Audio output is controlled by the knob, E-206.

Power input on frequencies higher than 60 cycles produces a background audio note of the same frequency as the power source. Weak signals can be received through this steady interference with very little loss in sensitivity by listening for an increase in the rate of random triggering while tuning the shorting bar, E-102. Therefore, distinguishing a weak signal from noise depends upon whether it will tune. Weak signals having pulse rates above 400 cycles will cause a rapid random operation of the trigger circuit as described above. Signals of lower repetition rate must be stronger in order to be recognized above the background interference. At 60 cycles repetition rate sensitivity will have dropped 6 DB.

PROCEDURE FOR SEARCHING

The long antenna, E-106, is used for searching from 80 to 300 megacycles. It must be retracted leaving E-104 to check the range from 300 to 3000 megacycles. Tuning is accomplished by slowly sliding the shorting bar, E-102, along the stub, E-108. The amplifier should be operated at maximum usable sensitivity. When a signal is received the "Proximity" control should be reduced as much as possible in order to sharpen tuning.

The setting for maximum usable sensitivity on the "Proximity" control is limited by the point beyond which the amplifier ceases to remain quiet without signal except for an occasional random triggering due to noise peaks. See page 33. An ideal installation would allow maximum gain on the "Proximity" control. In any case, the apparent signal to noise ratio may be improved by the lowest comfortable setting of the audio output control, E-206.

The antenna-detector unit is provided with two scales: a fixed scale graduated in centimeters, N-102, and a sliding scale graduated in megacycles, N-101. The carrier frequency of a signal which may be found at only one place on the tuning stub must be determined from the detector calibration curves, figure 18 , page 37. When a signal tunes at two or more places its carrier frequency may be read directly on the sliding scale.

DETERMINATION OF CARRIER FREQUENCY FROM THE CALIBRATION CURVES

With the long antenna, E-106, in place slowly tune the shorting bar, E-102, several times over its entire range to make certain that the signal can be heard only once. If the signal comes in only once:

(a) Read where the signal comes in and where it goes out on the centimeter scale and determine the mid-point. The mid-point is the value to be used when consulting the calibration curve. See operational note, page 43.

(b) Shorten the antenna by replacing the element E-106 with E-105.

(c) Repeat (a) above.

(d) Consult the antenna calibration curves page 37 , and record the possible frequencies for each antenna length. See sample data sheet, page 44.

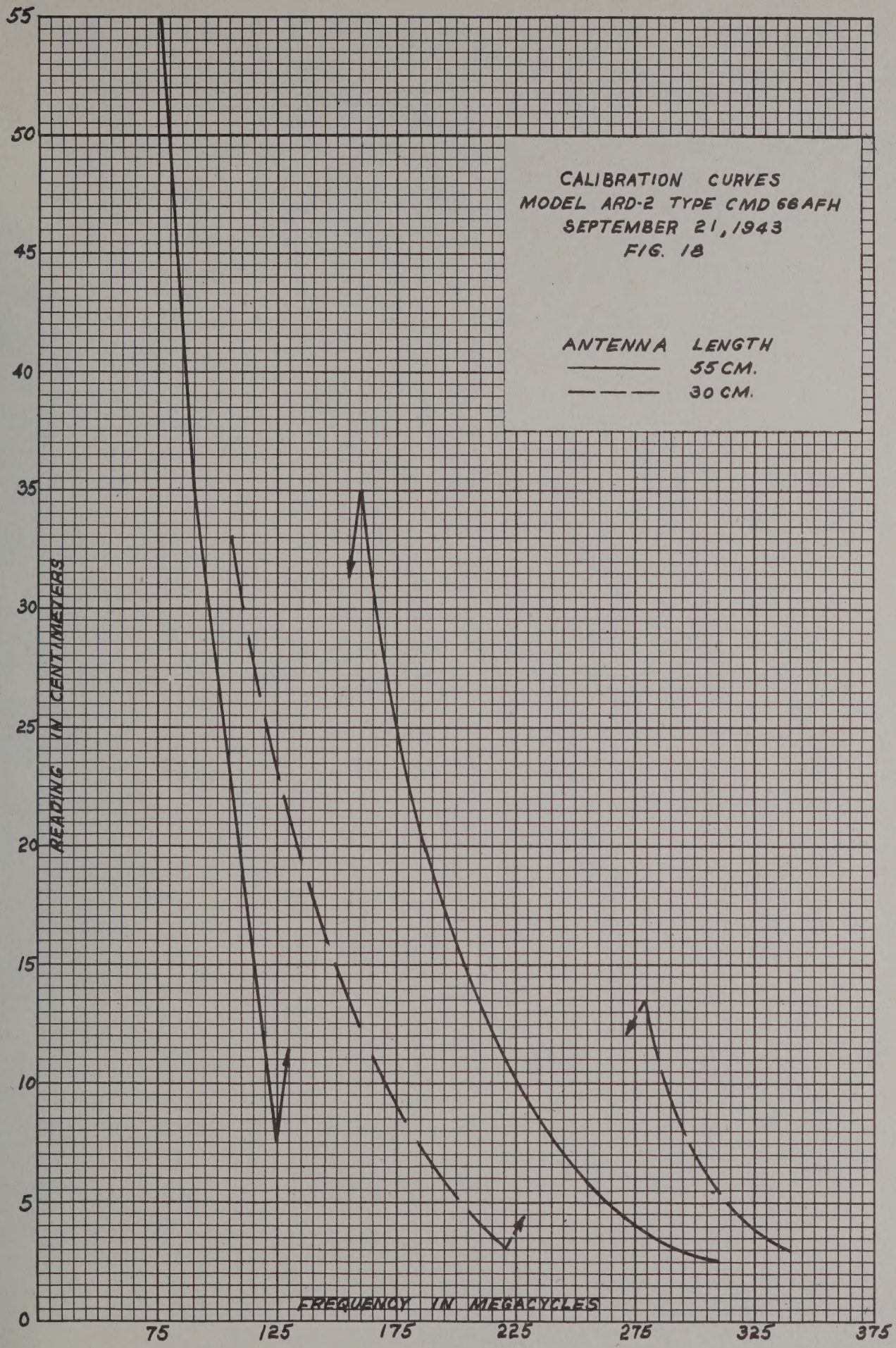

CALIBRATION CURVES
MODEL ARD-2 TYPE CMD 68AFH
SEPTEMBER 21, 1943
FIG. 18
ANTENNA LENGTH
55 CM.
30 CM.
READING IN CENTIMETERS
FREQUENCY IN MEGACYCLES
55
50
45
40
35
30
25
20
15
10
5
0
75
125
175
225
275
325
375

Figure 18

(e) One of the possible frequencies for the long antenna E-106, should approximate one of the possible frequencies for the medium antenna, E-105. The average of these two frequencies is recorded as the carrier frequency.

It is important that readings made only on the long and the medium length antennae be used when consulting the detector calibration curves.

If the above readings have been carefully taken and the closest frequencies seem unreasonably far apart, the readings on (b) above should be rechecked to make certain that the signal comes in only once.

The reading obtained for (a) or (b) above may be unsatisfactorily broad as the resonant frequency of either antenna is approached. However, examination of the calibration curves reveal that this condition cannot exist simultaneously on both antennae for any given frequency. If broadness is encountered on either antenna it is obviously impossible to average the two closest frequencies as detailed in (e) above. When the signal is broad on the long antenna, E-106, the carrier frequency is the lower of the two possible frequencies for the medium antenna, E-105. When the signal is broad on the medium antenna, E-105, the carrier frecuency is the higher of the two possible frequencies for the long antenna, E-106.

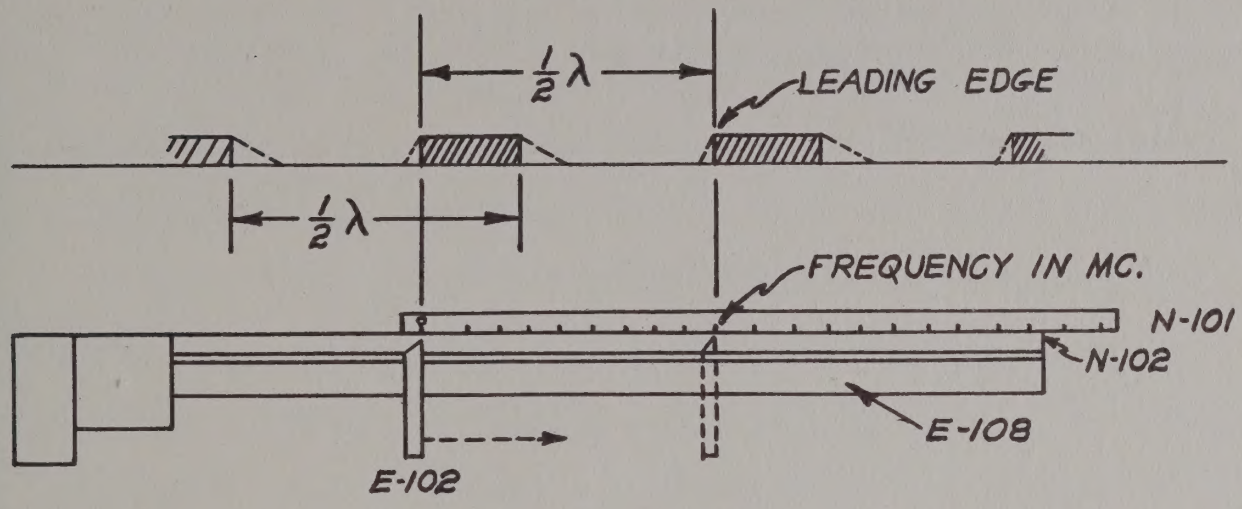
DETERMINATION OF CARRIER FREQUENCY ON THE SLIDING SCALE

(a) Establish that the signal may be found at two or more places along the tuning stub, E-108.

(b) Reduce the amplifier gain ("Proximity" control) to sharpen tuning, but not beyond the point which produces a clean signal in the phones. See operational note, page 43.

(c) Set the zero reference on the sliding indicator, N-101, opposite the leading edge of the first tuning point.

(d) Tune through the first tuning point by moving the shorting bar, E-102, until the leading edge of the second tuning point is found. Then read the carrier frequency directly on the sliding scale, N-101. Do not change the position of the "Proximity" control when going from (c) to (d).



It may be a matter of interest to note that the distance between these two reference points measures <u>one half</u> wave length on the centimeter scale, N-102. The formula: $f_{(mc)} = \frac{30,000}{(cm)}$ may be used to check this relation.

MEASUREMENT OF PULSE REPETITION RATES:

The pulse rate meter is calibrated directly in cycles per second. Pulse rate measurements require that the received signal be of sufficient strength to produce a <u>clean</u> note in the phones. Under this condition the meter will read a steady value and a clear note of one half the actual repetition rate will be heard. Too much pulse amplifier gain ("Proximity" control) gives unreliable readings. <u>Therefore, it is imperative that pulse rate measurements be taken with the least gain necessary to produce a clean signal</u>

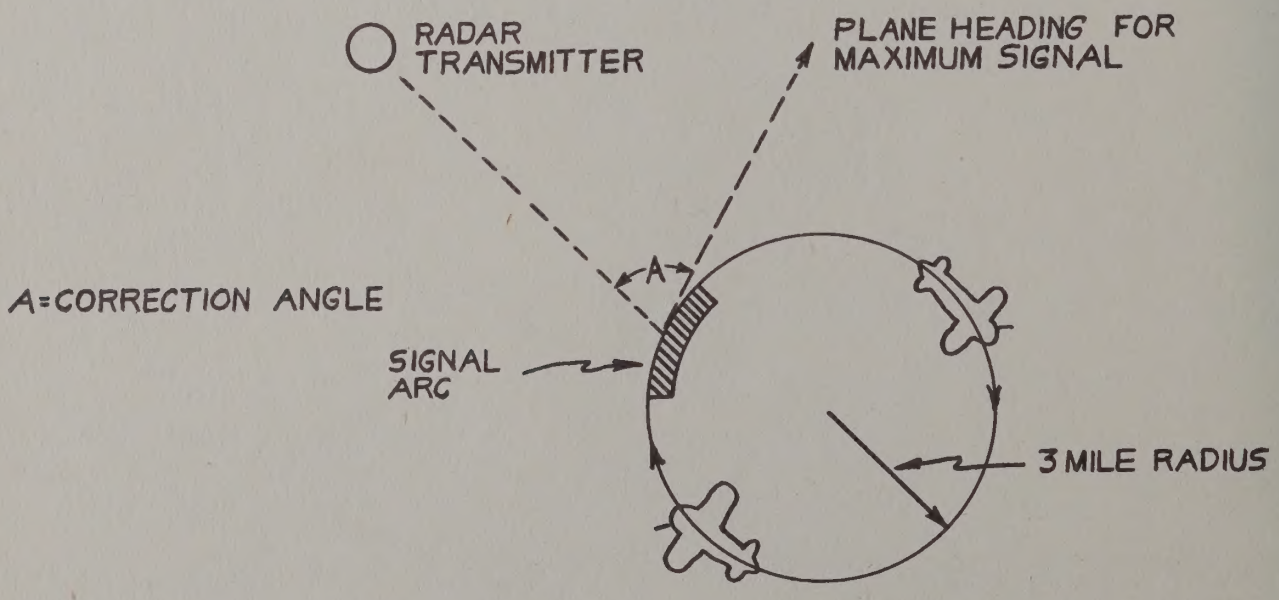
in the phones. When two radars are heard at the same time the meter will tend to indicate the sum of their repetition rates. An extremely quiet installation will give a clean signal 3 to 4 DB below the weakest tunable signal. As the noise increases this difference will increase so that a difference of 8 to 12 DB might occur.

PROCEDURE FOR CALIBRATING THE ARD-2 ANTENNA INSTALLATION

The experimental ARD equipment has been tested on a Navy patrol bomber, type PBM-3, to determine the procedure for securing d-f bearings and for making homing runs on radar transmitters.

The directive properties of the ARD antenna depend upon its proximity to large metal surfaces. In the test location on the PBM-3 the maximum antenna response was forward and off to port by an angle which varied with frequency as shown below:

Frequency (Megacycles)	Correction Angle a (Degrees)	Antenna Length (Centimeters)
100	19	56
200	28.5	56
400	25	16
515	40	16
700	35.5	16



The data for these frequencies was obtained by flying in a circle of three mile radius while approximately thirty-five miles from the radar transmitter. The first time around, a given signal could be heard at several places on the circle course. Then the amplifier gain was reduced until this signal could be received over only a small arc. Compass readings were taken at the points where the signal came and where it went out. The mean of these readings was assumed to be the heading of the plane for maximum signal. See operational note, page 43. The circular course was plotted on the navigator's chart and a line drawn tangent to this circle to represent the heading of the plane at the instant of maximum response.[7] The angle between this line and a line drawn directly to the radar transmitter from the same point became the correction angle for that frequency.

It is important that the antenna length be shortened, E-104, for frequencies above 300 megacycles in order to avoid the multiple lobes which occur when the antenna is too long.

BEARINGS ON RECEIVED SIGNALS

Homing is achieved by flying in a circle and adjusting the amplifier gain ("Proximity" control) until the signal is heard over only a small arc. Compass readings are taken when the signal comes in and when it goes out and the center of the arc determined. See operational note, page 43. This gives the heading of the plane for maximum response. The correction angle previously determined for that frequency must then be applied to give the course the plane should follow in order to fly toward the radar transmitter.

---

7. A correction for magnetic deviation may be required before plotting the heading of the plane on the navigator's chart.

The frequency corrections determined above were checked for homing on 200, 400, and 700 megacycles. In each case the course led directly to the radar transmitter when a correction for wind drift was applied. A bearing accuracy of one or two degrees may be attained by this method. If a plane starts its run at a distance of 50 miles it should come within 1 mile of the transmitter with a bearing error of 1 degree. It is possible to spiral in when no correction measurement is available for a particular frequency, by assuming a correction angle and taking several bearings on the received signal.

The range of the experimental ARD equipment has proven to be two or three times the maximum range at which a radar operator could distinguish the plane. When an approach was made at very low altitude (50 feet) the plane could come within five or ten miles before being picked up on either a 400 megacycle or a 700 megacycle radar system. These results demonstrate the possibility of homing on transmissions from enemy fleet units or shore stations with a considerable element of surprise.

CAUTION

When searching for radar stations it is best to change course periodically in order to minimize the possibility of missing a signal due to the shielding action of large metal surfaces on the plane. The shorting bar, E-102, should be moved slowly over the entire length of the tuning stub, E-108, to avoid overlooking a signal from a rotating radar antenna. The altitude should also be varied plus or minus a thousand feet before it may be assumed that no radar stations are operating within the range of the ARD-2 receiver.

OPERATIONAL NOTE

An alternate method for determining the position of carrier frequency tuning points may be used provided that noise interference is satisfactorily low and the received signal is of sufficient strength. This depends upon setting the "Proximity" control slightly below the level required to key the trigger circuit. Then the visual signal indicator acts as a peak tuning device because the received signal is passed by the trigger circuit in its true relative intensity.

PATTERNS ON VISUAL SIGNAL INDICATOR

It has not been possible to test this procedure in the field. However, there is a great advantage in being able to recognize immediately the proper position of the shorting bar, E-108, for maximum response. This eliminates determining the mid-point of the region on the tuning stub over which a given signal will key the trigger circuit. Carrier frequency measurements which require consulting the detector calibration curves can be simplified by this means.

RECOMMENDED DATA SHEET FOR ARD-2 LOG

(Note: Figures entered below obtained from X-ARD calibration curve.)

Stub Setting In Cm.		Carrier Freq. In Megacycles				Pulse Rate ~/sec	Time	Date	Name
Long Antenna (E-106)	Medium Antenna (E-105)	E-106	E-105	Mean	N-101				
TEST OSCILLATOR + SERIAL NUMBER ____									
					___	___			
						___			
						___			
						___			
Signal in 16	6								
Signal out 24	10								
Mid point 20	8	~~125~~ 200	195 ~~325~~	197.5		60	1015	8/5/43	CEK
					430	1600	1232	8/5/43	LWB

VI MAINTENANCE

The ARD-2 equipment should be inspected frequently to insure peak performance.

It is important that the sliding contacts on the inner and outer portions of the tuning stub, E-108, be kept tight and clean. Bright metal should be maintained between the tapered bearing surface inside the top of the permanent antenna section, E-104, and the cone on the removable pieces, E-105 and E-106. The detector plate clip, E-107, and cathode contact, E-109, must be kept snug and properly aligned. Firm electrical contacts are necessary throughout the antenna-detector unit to minimize noise generated by mechanical vibration.

A routine check should include the following items:

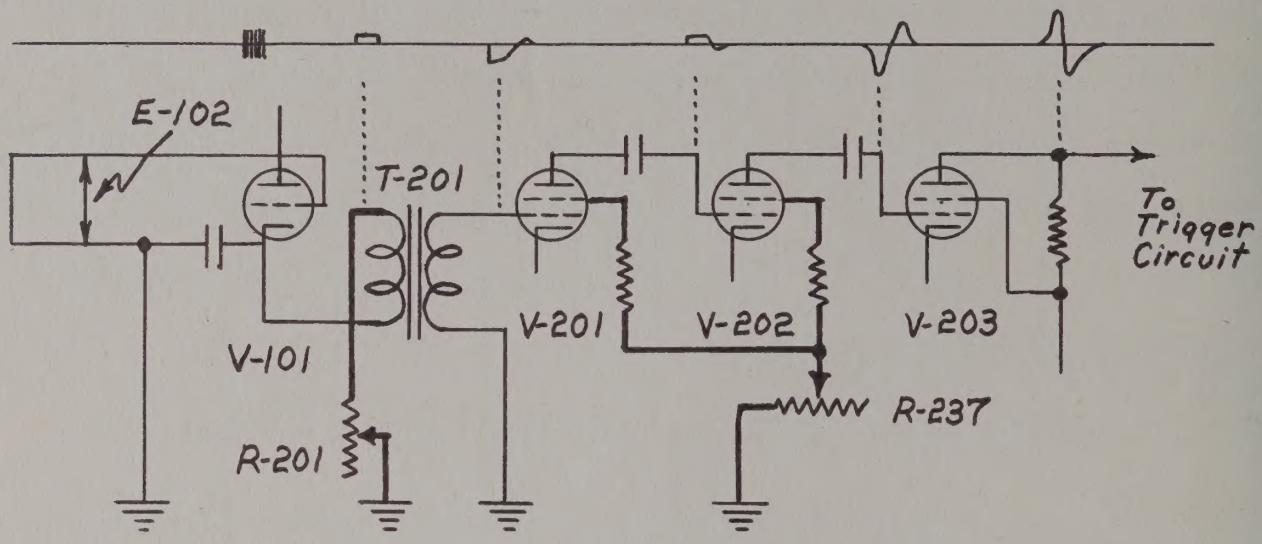
1. Test tubes (detector tube type 446 should be tested as a diode).
2. Make a thorough inspection of all soldered connections, clearances between terminal points, moving parts (knobs, and antenna slider), switches and tighten all hardware (nuts and bolts etc.).
3. Look for oil leaks on "bathtub" condensers.
4. Observe discoloration or signs of wax running which suggest overheating of resistors.
5. Make a system check using the test oscillator. Also, observe whether pulse rate readings are reasonably close to those recorded in the log book when the equipment was originally installed.

TROUBLE SHOOTING

It should be possible to trace any difficulty in circuit operation of the ARD-2 equipment by using a standard volt-ohm meter and referring to the chart of point to point voltage

measurements on page 53, as well as the complete circuits on pages 50-52.

Wave form oscillograms are shown below in their relation to simplified schematics of the antenna-detector, pulse amplifier, trigger circuit and pulse rate counter. Checking these may help to isolate trouble occurring in a single stage.



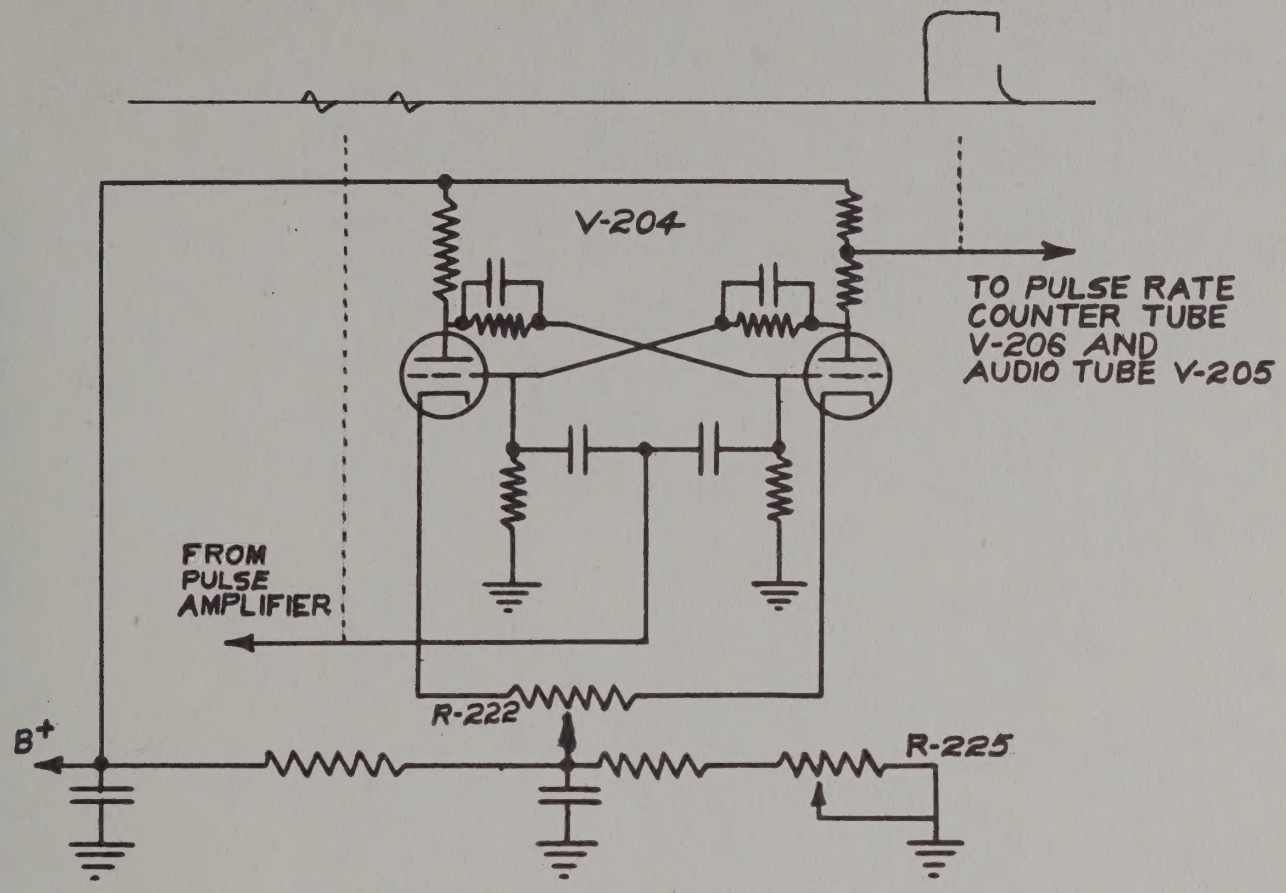
ANTENNA-DETECTOR AND PULSE AMPLIFIER WAVE FORMS[8]

R. F. pulses induced in the antenna are rectified by the diode detector and fed into the coupling transformer, T-201. There is some gain across T-201 and phasing to give proper polarity of pulse input for the trigger circuit. The setting of the diode bias control, R-201, is described under ADJUSTMENTS, page 33.

Varying the screen voltage by the "Proximity" control, R-237, determines the amplification of V-201 and V-202. The last

8. An expanded sweep of 50 micro-seconds was used to obtain these wave forms. Ordinary oscilloscope equipment should reveal the same relative amplitude, but the wave forms will be compressed along the X axis.

stage of the pulse amplifier, V-203, limits the amplitude of the pulses and somewhat reduces the overshoot.



TRIGGER CIRCUIT WAVE FORMS

The values in the trigger circuit have been chosen so that one triode is conducting while the other is cut off. A pulse from V-203 causes the conducting triode to be cut off and the non-conducting triode to conduct. A second pulse from V-203 is required to reverse this condition. Thus two pulses are needed to produce one square wave and the square wave frequency is one half of the pulse repetition rate.

The potentiometer, R-222, is used to "Balance" the trigger circuit. A variable control is necessary to compensate for

differences in the triode sections and associated parts[9]. The "Balance" control, R-222, can be adjusted as follows:

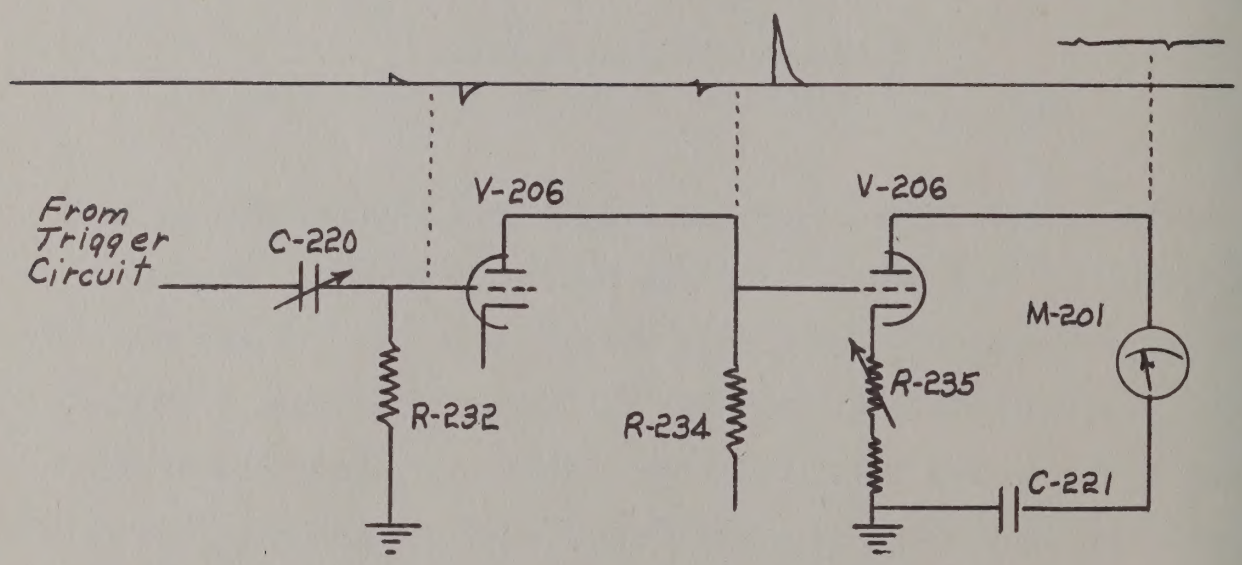
1. Set the "Proximity" control, R-237, at the minimum gain position, marked "near" on the amplifier front panel.

2. Advance the trigger circuit "Sensitivity" control, R-225, to the point of oscillation. Then back it off to the very edge of oscillation.

3. Turn the "Balance" control, R-222, to the center of the arc where it causes oscillation.

4. Repeat (2) and (3) above until the "Balance" control is set as nearly as possible at the exact center of the arc where it causes oscillation.

5. The position of the sensitivity control, R-225 should be turned back about thirty degrees as described in the section on ADJUSTMENTS, page 33.

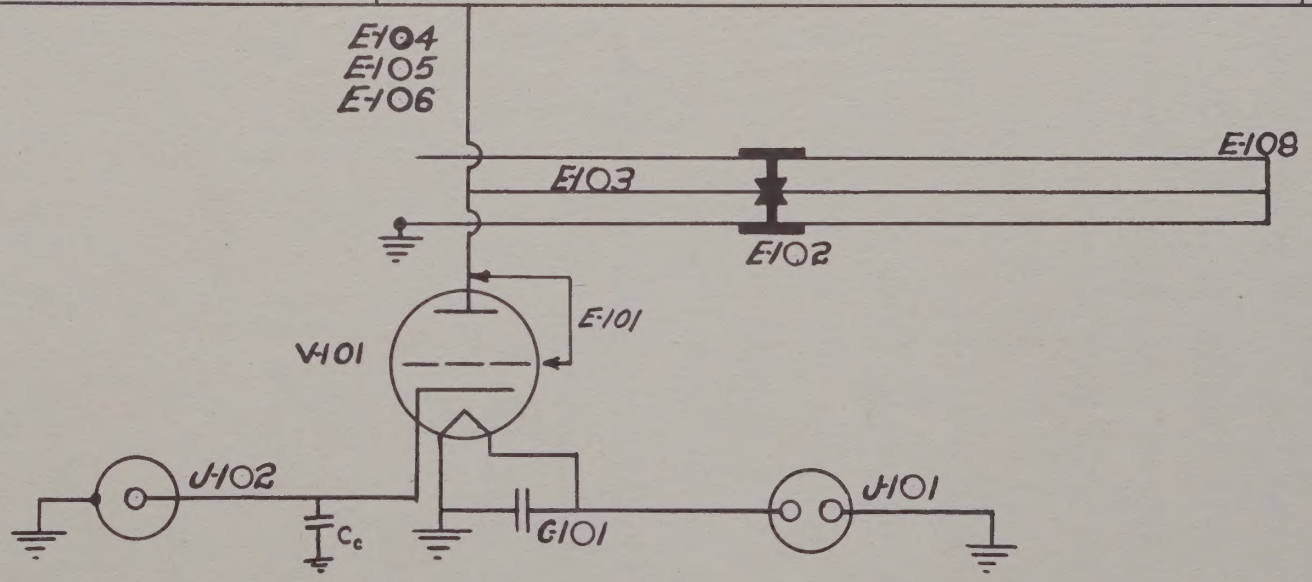


PULSE RATE COUNTER WAVE FORMS

9. R-217, R-218 and R-220, R-221 should be paired resistors ± 3%. Their exact value is not critical, but it is important that they be closely matched.

Square wave input from the trigger circuit is differentiated by the RC network R-232 and C-220. The resulting pulses are amplified in the first triode of V-206 and integrated in the plate circuit of the second half of this tube to operate the meter, M-201. Optimum values for R-232 and C-220 have been determined in the course of production. IMPORTANT: The accuracy of pulse rate meter readings depends upon the setting of C-220 and R-235 in relation to a particular 6SN7GT tube. Therefore, the tube, V-206, is marked and should not be exchanged unless a calibrated pulse signal source is available. If it should be necessary to replace this tube, the pulse counter circuit can be roughly recalibrated by adjusting the "Calibration" control, R-235, so that the test oscillator pulse rate readings correspond with those recorded in the log when the equipment was installed. The condenser C-220 is used to track the response curve of the counter circuit with the dial scale on the meter, M-201. It should not be distrubed because it requires a calibrated pulse signal source of continuously variable repetition rate.

CAUTION	TOLERANCES	MANUFACTURER'S No.
READ ALL NOTES BEFORE STARTING WORK. DO NOT SCALE DRAWING. WORK TO DIMENSIONS. ALL DIMENSIONS GIVEN IN INCHES.	UNLESS SPECIFIED WITH LIMITS DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± .010	SCIA



C_c 30 mmfd. tube capacitance

ITEM	REQ.	M'F'R'S. No.	PART No.	DESCRIPTION	USED ON	No.
11	1		E-101	GRID-PLATE CONNECTOR		
10	1		E-108	OUTER CONDUCTOR		
9	1		E-106	LONG ANTENNA		
8	1		E-105	MEDIUM ANTENNA		
7	1		E-104	SHORT ANTENNA		
6	1		E-103	INNER CONDUCTOR		
5	1		E-102	POINTER & PISTON		
4	1		V-101	GL-446A		
3	1		J-101	AN-3102-12S-3S		
2	1		J-102	COAX CONNECTOR NAVY #49194		
1	1		C-101	.005 MFD. 500 V. MICA CONDENSER		

ISSUE	REVISION	DATE	APPR'D
K			
J			
H			
G			
F			
E			
D			
C			
B			
A			

MANUFACTURER MIDWEST RADIO CORP. TITLE DETECTOR & ANTENNA

QUANT. FINISH

MATERIAL

SCALE NONE DATE 7-20-43 JOB WJ 7

DRAWN J.W.S. CHECK'D APPROVED PART No. SCIA

MIDWEST RADIO CORP., 909-11 BROADWAY, CINCINNATI, OHIO

Figure 19

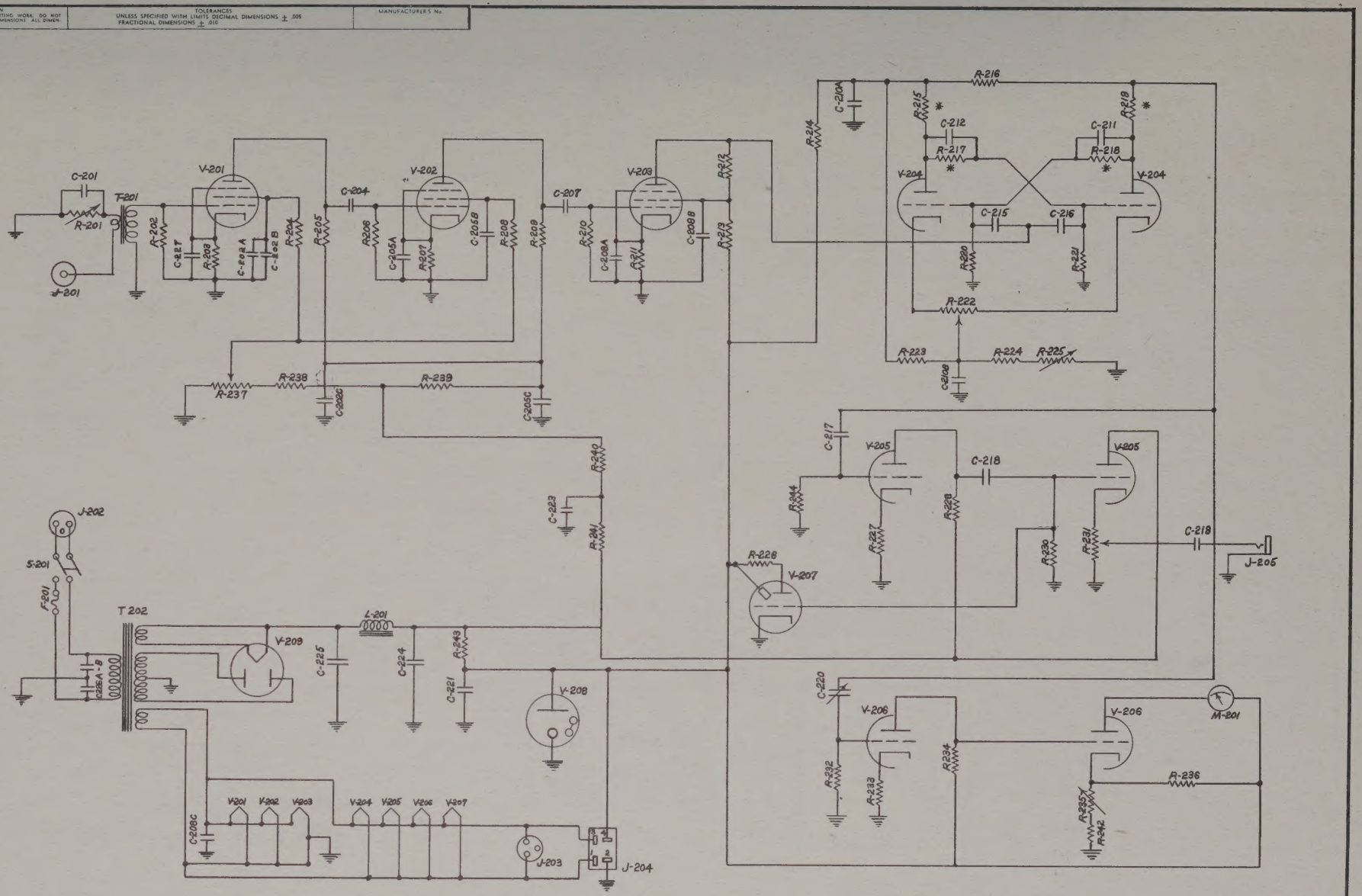


Figure 20
51

ITEM	REQ.	PART No.	DESCRIPTION
25		R-201	10,000 ohm potentiometer
24		R-202	10,000 ohm ½-watt
23		R-203	180 " " "
22		R-204	10,000 " " "
21		R-205	27,000 " " "
20		R-206	270,000 " " "
19		R-207	220 " " "
18		R-208	10,000 " " "
17		R-209	27,000 " " "
16		R-210	270,000 " " "
15		R-211	2200 " " "
14		R-212	15,000 " " "
13		R-213	33,000 " " "
12		R-214	2200 " " "
11		R-215	56,000 " " "
10		R-216	47,000 " " "
9		R-217	560,000 " " "
8		R-218	560,000 " " "
7		R-219	10,000 " " "
6		R-220	270,000 " " "
5		R-221	270,000 " " "

Part No.	Description
R-222	10000 ohm potentiometer
R-223	68,000 ohm 1 watt
R-224	6800 " " "
R-225	10,000 ohm potentiometer
R-226	10 megohm ½ watt
R-227	1500 ohm ½ watt
R-228	470,000 ohm ½ watt
R-230	3.3 megohm " "
R-231	10,000 ohm potentiometer
R-232	.68 megohm ½ watt
R-233	1500 ohm ½ watt
R-234	470,000 ohm ½ watt
R-235	10,000 ohm potentiometer
R-236	22,000 ohm 1 watt
R-237	10,000 ohm potentiometer
R-238	100,000 ohm ½ watt
R-239	2200 " " "
R-240	2200 " " "
R-241	4700 " " "
R-242	3300 " " "

Part No.	Description
R-243	4400 ohm 5 Watt
R-244	20 megohm ½ watt
C-202	3 X .1 Mfd. 600 V. Paper
C-205	3 X .1 Mfd. 600 V. Paper
C-208	3 X .1 Mfd. 600 V. Paper
C-210	2 X .1 Mfd. 400 V. Paper
C-211	50 MMfd. Ceramicon
C-212	50 MMfd. Ceramicon
C-215	25 MMfd. Ceramicon
C-216	25 MMfd. Ceramicon
C-217	.005 Mfd. 400 V. Mica
C-218	.005 Mfd. 400 V. Mica
C-219	.5 Mfd. 400 V. Paper
C-220	7-47 MMfd. Variable Ceramic
C-221	4 Mfd. 600 V. Paper
C-223	4 Mfd. " "
C-224	4 Mfd. " "
C-225	4 Mfd. " "
C-226	2 X .1 Mfd. 400 V. Paper
S-201	D.P.S.T. Toggle Switch
C-201	.5 Mfd. 400 V. Paper

Part No.	Description
C-204	.005 Mfd. 400 V. Mica
C-207	.005 Mfd. " "
F-201	2 Amp. 250 V. Fuse
L-201	11 H Choke
M-201	0-1 Milliameter
T-201	Pulse Transformer
T-202	Power Transformer
V-201	6AC7 Tube
V-202	6AC7 Tube
V-203	6AC7 Tube
V-204	6SL7 GT Tube
V-205	6SN7 GT Tube
V-206	6SN7 GT Tube
V-207	6E5 Tube
V-208	VR-150-30 Tube
V-209	5Y3GT Tube
J-201	Selector Plug Navy Type 49184
J-202	AN-3102-14S-7P
J-203	AN-3102-14S-9S
J-204	Jones Socket S304AB
J-205	Phone Jack

*Note: These resistors matched pairs.

REVISION	DATE	APP'D
Replaced	9-15	WL
Interchanged R-238 & R-239	8-18	WL
CHANGED PART	8-11-43	WL

C-227 .02 mfd. 15 V.D.C. paper

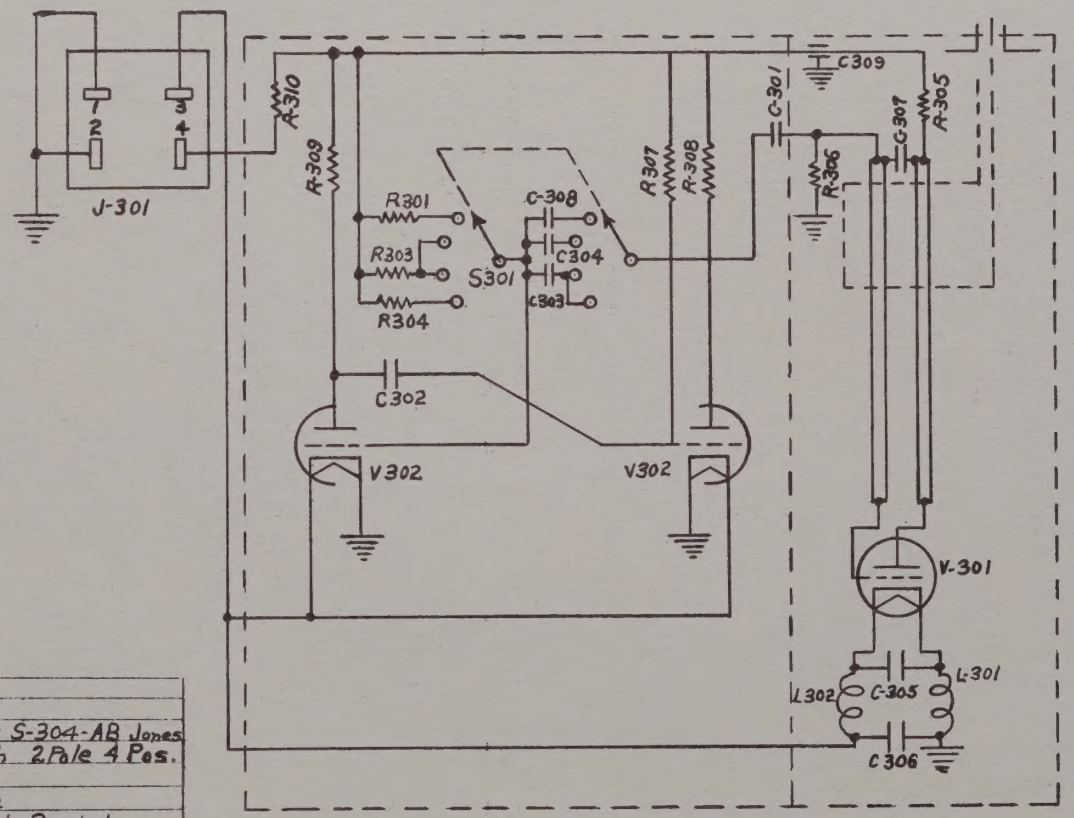
MANUFACTURER MIDWEST RADIO CORP. TITLE AMPLIFIER ARD-2

FINISH QUANT. MATERIAL

SCALE NONE DATE 5-28-43 JOB WJ7

DRAWN H.J.G. CHECK'D WL APPROVED PART No. SC-2-C

MIDWEST RADIO CORP., 909-11 BROADWAY, CINCINNATI, OHIO



ITEM	REQ.	PART No.	DESCRIPTION
		L302	R.F. Choke
		L301	R.F. Choke
		J301	Socket 4 Contact S-304-AB Jones
		S301	Selector Switch 2 Pole 4 Pos.
		V302	6SL7GT Tube
		V301	955 Acorn Tube
		R310	1000 Ohm ½ Watt Resistor
		R309	2200 Ohm ½ Watt Resistor
		R308	2200 Ohm ½ Watt Resistor
		R307	1.0 Megohm ½ Watt Resistor
14		R306	8000 Ohm ½ Watt Resistor
13		R305	8000 Ohm ½ Watt Resistor
12		R304	3.3 Megohm ½ Watt Resistor
11		R303	6.8 Megohm ½ Watt Resistor
10		R301	15 Megohm ½ Watt Resistor
9		C309	.55 MMF Capacitor Feed Thru
8		C308	.1 MFD 600 W.D.C.V. Paper
7		C307	100 MMF Mica Toothpick
6		C306	500 MMF Button Mica
5		C305	100 MMF Ceramicon
4		C304	500 MMF Mica
3		C303	200 MMF Mica
2		C302	100 MMF Ceramicon
1		C301	25 MMF Ceramicon

ISSUE	REVISION	DATE	APPR'D
A	added arrows	8-12-43	WR

CAUTION: READ ALL NOTES BEFORE STARTING WORK. DO NOT SCALE DRAWING. WORK TO DIMENSIONS. ALL DIMENSIONS GIVEN IN INCHES.

MANUFACTURER'S No.

TOLERANCES: UNLESS SPECIFIED WITH LIMITS. DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± .010

MANUFACTURER MIDWEST RADIO CORP. | TITLE TEST OSCILLATOR UNIT

QUANT. | FINISH | MATERIAL

SCALE None | DATE 7-22-43 | JOB WJ 7

DRAWN H.J.G | CHECK'D WR | APPROVED | PART No. SC 3-A

MIDWEST RADIO CORP., 909-11 BROADWAY, CINCINNATI, OHIO

USED ON | No.

Figure 21
52

AMPLIFIER VOLTAGE CHART

SYMBOL	TUBE	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8
V-201	6AC7	GND.	GND.	GND.	0	0 * .5V.	0 * 35V.	6.3 A.C.	235V. * 137V.
V-202	6AC7	GND.	GND.	0 * .57V.	-.2V.	0 * .57V.	0 * 36V.	6.3 A.C.	235V. * 143V.
V-203	6AC7	GND.	GND.	2.2V.	0	2.2V.	100V.	6.3 A.C.	85V.
V-204	6SL7GT	** 26V.	80V. ** 90V.	29V. ** 31V.	** 35V.	75V. ** 86V.	28V. ** 34V.	GND.	6.3 A.C.
V-205	6SN7GT	0	1.57V	.55V.	-.13V.	290V.	13V.	GND.	6.3 A.C.
V-206	6SN7GT	0	.82V.	.27V.	.82V.	150V.	22V.	GND.	6.3 A.C.
V-207	6E5	GND.	** 18V.	-.13V.	150V.	GND.	6.3V.	——	——
V-208	VR150-30	290V.	GND.	N.C.	285V.	150V.	300V.	N.C.	N.C.
V-209	5Y3GT	N.C.	315V.	N.C.	252 A.C.	N.C.	252 A.C.	N.C.	315V.

Readings taken from ground with 1000 ohms per volt meter, controls off, no signal in.

* "Proximity" control turned on full.

** Readings taken with vacuum tube voltmeter.

N.C. : No connection.

GND. : Ground potential.

Figure 22

Description: Sharp Cutoff R-F Pentode

Ratings Absolute Maximum:	Ef V	Eb_b Vdc	Ecc2 Vdc	Ec3 Vdc	Rk Ohms	Pp W	Pg2 W	Ehk V
	6.3±10%	330	165	---	---	3.3	0.45	100
Test Cond:	6.3	300	150	0	160	---	---	100

*Height: Max. 2.63 in. *Diameter: Max. 1.32 in.

**Base: Small Wafer Octal 8-Pin Phenolic

**Pin No:	1	2	3	4	5	6	7	8
Element:	sh	h	g3	g1	k	g2	h	p

**Cathode: Coated Unipotential
**Envelope: MT-8 (5-3)

Ref.	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop:					
F-6b(1)	*Vibration:	Rp=2000	Ep:	---	500	mVac
F-6i	*Heater Current:		If:	425	475	mA
F-6q	*Insulation:		Ihk:	0	20	uAdc
F-6g(1)	+Grid Current:	Ec3=2Vdc	Ic3:	0	-6.0	uAdc
F-6f(1)	Plate Current:		Ib:	8.0	12.5	mAdc
F-6f(1)	Plate Current:	Ec1=6Vdc	Ib:	0	900	uAdc
F-6f(3)	*Screen Current:		Ic2:	1.6	3.4	mAdc
F-6j	Transconductance:	Note 1	Sm:	7000	12,500	umhos
F-6j	*Transconductance:	Ef=5.5V;Note 1	Sm:	5500	---	umhos
F-6e(1)	R-F Noise:	Esig=70 mVac				
F-6c(1)	+Emission:	Eb=Ec1=Ec2=Ec3=10 Vdc	Is:	40	---	mAdc
F-6p	*Capacitance:		Cgp:	---	0.015	uuf
			Cin:	8.8	13.2	uuf
			Cout:	3.5	6.5	uuf
F-4	Life Test:	Group A	t:	500	---	hrs
F-4b	Life Test End Point:	Transconductance:	Sm:	5800	---	umhos

Note 1. Rk may be by-passed with a condenser; a value of 1000 uf is suitable for 60 cps signal.

THIS SHEET OF TEST LIMITS IS A PART OF SPECIFICATION JAN-1A

Description: Twin Triode High-Mu Amplifier

Ratings	Ef	Eb	Ec	Pp	Ehk
Absolute	V	Vdc	Vdc	W	V
Maximum:	6.3±10%	275	---	1.1	100
Test Cond:	6.3	250	-2	---	100

*Height: Max. 3.32 in. *Diameter: Max. 1.32 in.

**Base : Intermediate Shell Octal 8-Pin, Phenolic

**Pin No.:	1	2	3	4	5	6	7	8
Element:	2g	2p	2k	1g	1p	1k	h	h

**Cathode: Coated Unipotential
**Envelope: T-9 (3-6)

Ref.	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop:					
F-6b(1)	*Vibration:	Rp=2,000; Note 2	Ep:	---	400	mVac
F-6i	*Heater Current:		If:	275	325	mA
F-6q	*Heater Insulation:	Note 1	Ihk:	0	20	uAdc
F-6g(1)	+Grid Current:	Note 1	Ic:	0	-1.0	uAdc
F-6f(1)	Plate Current:	Note 1	Ib:	1.5	3.1	mAdc
F-6f(1)	*Plate Current:	Ec=5.5 Vdc; Note 1	Ib:	0	25	uAdc
F-6l(1)	*Amplification Factor:		Mu:	55	85	
F-6j	*Transconductance:	Note 1	Sm:	1300	1900	umhos
F-6l(2)	A-C Amplification:	Esig=0.2Vac; Notes 1 & 3	Ep:	8.2	---	Vac
F-6e(2)	A-F Noise:	Esig=25mVac; Rp=0.2Meg; Note 2				
F-6c(1)	+Emission:	Eb=Ec=30Vdc; Note 1	Is:	40	---	mAdc
F-4	Life Test:	Group A: Ec=-1.0 Vdc Note 2	t:	500	---	hrs.
F-4b	Life Test End Point:	A-C Amplification or	Ep:	7.0	---	Vac
		Transconductance	Sm:	1040	---	umhos

Note 1. Test each unit separately.

Note 2. Tie plate No. 1 to plate No. 2; tie grid No. 1 to grid No. 2; tie cathode No. 1 to cathode No. 2 at socket.

Note 3. Ebb=100 Vdc; Ecc=0; Rp=0.25 Meg.

THIS SHEET OF TEST LIMITS IS A PART OF SPECIFICATION JAN-1A

Description: Twin Triode

Ratings	Ef	Eb	Ec	Ehk	1 lk	1 2k	Pp
Absolute	V	Vdc	Vdc	V	mAdc	mAdc	W
Maximum:	6.3±10%	330	---	100	20	20	2.75
Test Cond:	6.3	250	-8	100	---	---	---

*Height: Max. 3.32 in. *Diameter: Max. 1.32 in.
**Base : Intermediate Shell Octal 8-Pin, Phenolic

**Pin No.:	1	2	3	4	5	6	7	8
Element:	2g	2p	2k	lg	lp	lk	h	h

**Cathode: Coated Unipotential
**Envelope: T-9 (3-6)

Ref.	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop:					
F-6b(1)	*Vibration:	Rp=2000; Note 1	Ep:	---	150	mVac
F-6i	*Heater Current:		If:	550	650	mA
F-6q	*Insulation:	Note 1	Ihk:	0	20	uAdc
F-6g(1)	+Grid Current:	Note 2	Ic:	0	-2.0	uAdc
F-6f(1)	Plate Current:	Note 1	Ib:	5.5	12.5	mAdc
F-6f(1)	*Plate Current:	Ec=24Vdc: Note 1	Ib:	0	5	uAdc
F-6j	*Transconductance:	Eb=90Vdc;Ec=0 Note 1	Sm:	2400	3600	umhos
F-6j	Transconductance:	Note 1	Sm:	2075	3125	umhos
F-6l(1)	*Amplification Factor:	Note 1	Mu:	18	22	
F-6e(2)	A-F Noise:	Esig=50mVac; Rp=10,000; Note 2				
F-6c(1)	+Emission:	Eb=Ec=30Vdc;Note 1	Is:	40	---	mAdc
F-4	Life Test:	Group A;Note 2	t:	500	---	hrs.
F-4b	Life Test End Point:	Transconductance;	Sm:	1550	---	umhos

Note 1. Test each unit separately.

Note 2. Tie plate 1 to plate 2; tie grid 1 to grid 2 at socket tie cathode 1 to cathode 2 at socket.

July 31, 1943

THIS SHEET OF TEST LIMITS IS A PART OF SPECIFICATION JAN-1A

Description: Electron-Ray Tube, Indicator Type

Ratings Absolute Maximum:	Ef V	Ebb Vdc	Eb Vdc	Ec Vdc	Eta Vdc	Ehk V
	6.3±10%	275	---	---	100-275	100
Test Cond:	6.3	---	250	-4	250	100

*Height Min. 3.8 in. Max. 4.19 in. *Diameter: Max. 1.19 in.

**Base: Small 6-Pin, Phenolic

**Pin No.:	1	2	3	4	5	6	Note 1
Element:	h	p	g	ta	k	h	

**Cathode: Coated Unipotential
**Envelope: T-9 (1-4)

Ref.	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop					
F-6b(1)	*Vibration:	Eb=100 Vdc; Ec=-1Vdc Rp=10,000	Ep:	---	150	mVac
F-6i	*Heater Current:		If:	275	325	mA
F-6q	*Insulation:		Ihk:	0	20	uAdc
F-6g(1)	†Grid Current		Ic:	0	-1.0	uAdc
F-6f(1)	*Plate Current:		Ib:	3.4	7.2	mAdc
F-6f(5)	Target Current:		Ita:	0.2	6.0	mAdc
---	Pattern Check: Ec=6Vdc; Rp=1Meg; Note 2					
---	Pattern Check: Ec=10.5Vdc; Rp=1Meg; Note 3					
F-6c(1)	†Emission:	Eb=Eta=Ec=30 Vdc	Is:	15	---	mAdc
F-4	Life Test:	Rp=1.0 Meg; Group A	t:	500	---	hrs.
F-4b	Life Test End Point: Target Current; Note4		Ita:	---	6.5	mAdc

Note 1. The shadow electrode shall fall within ±12° of a line parallel to a plane passing through the base pins for the plate and cathode (Pins No. 2 & 5), and shall be located over the cathode pin (Pin No. 5)

Note 2. The pattern shall not meet for more than 1/2 of radial width of pattern.

Note 3. The pattern shall meet at some point. Tubes having images which show dark areas, sponginess, or poor illumination shall be rejected.

Note 4. and when the tube fails to meet either of the pattern check tests.

THIS SHEET OF TEST LIMITS IS A PART OF SPECIFICATION JAN-1A

Description: Voltage Regulator

Ratings	Ebb	Starting Voltage	Operating Voltage	Operating Current
	Vdc	Vdc	Vdc	mAdc
	---	180 (Min.)	150 (Approx.)	5 (Min.) to 40 (Max.)
Test Cond:	300	---	---	---

*Height: Min. 4.0 in. Max. 4.13 in. *Diameter: Max. 1.57 in.

**Base: Small shell, Octal 6-Pin, Phenolic

**Pin No.:	1	2	3	5	7	8
Element:	nc	k	7	a	3	nc
			Note 1			

**Cathode: Glow Discharge.
**Envelope: ST-12(4-4)

Ref.	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop:					
F-6b(1)	*Vibration:	No Voltages				
F-2	Electrode Insulation:	Omit Test				
F-9a	+Ionization Voltage:	Rp/Ib=30 mAdc	Ez:	---	180	Vdc
F-9b	Plate Voltage:	Rp/Ib=40 mAdc; Note 2	(1)Eb:	---	162	Vdc
F-9b	Plate Voltage:	Rp/Ib=30 mAdc; Note 2	(2)Eb:	---	160	Vdc
F-9b	Plate Voltage:	Rp/Ib=5 mAdc; Note 2	(3)Eb:	147	---	Vdc
F-9b(1)	Regulation:	(1)Eb-(3)Eb	(1) Reg:	---	5.5	Vdc
F-9b(1)	Regulation:	$(_2)$Eb-$(_3)$Eb	$(_2)$ Reg:	---	3.5	Vdc
F-9c	Leakage Current:	Eb=50 Vdc	Ipk:	---	1.0	uAdc
F-9d(1)	Oscillation:	Rp/Ib 5-40 mAdc;Note 2				
F-9d(2)	*Noise:	Rp/Ib=40 mAdc; Note 2	Ep:	---	1.0	mVac
F-4	Life Test:	Group A; Note 2 Rp/Ib=30 mAdc	t:	500	---	hrs.
F-4b	Life Test End Point:	Ionization; and	Ez:	---	185	Vdc
		Plate Current and	(1)Eb:	---	165	Vdc
		Plate Current and	(2)Eb:	---	163	Vdc
		Plate Current and	(3)Eb:	142	---	Vdc
		Regulation and	(1)Reg:	---	5.5	Vdc
		Regulation	(2)Reg:	---	3.5	Vdc

Note 1. Pins 3 and 7 tied internally. No external Connection.

Note 2. Fixed resistor may be used and Ebb varied to give desired current.

THIS SHEET OF TEST LIMITS IS A PART OF SPECIFICATION JAN-1A

Description: Full-Wave High-Vacuum Rectifier

Ratings	Ef	epx	Epp	ib	Ic	RL	CL	i surge
Absolute	Vac	vac	Vac	ma	mAdc	ohms	uf	a
Maximum:	5.0±10%	1550	---	415	140	----	--	1.4
Test Cond:	5.0	---	400	---	---	2700	4	---

*Height: Max. 3.38 *Diameter: Max. 1.31 in.

**Base : Intermediate Shell Octal 5-Pin, Phenolic

**Pin No.:	1	2	4	6	8
Element:	nc	f	2p	1p	f

**Cathode: Coated Filament
**Envelope: T-9 (3-9)

Ref.	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop:					
F-6b(1)	*Vibration:	No voltages				
F-6i	*Filament Current:		If:	1.8	2.2	Aac
F-6n	+Operation:	Note 1	Io:	120	---	mAdc
F-6c(1)	Emission:	E2b=0;E1b=75 Vdc	Ils:	120	220	mAdc
F-6c(1)	Emission:	E1b=0; E2b=75Vdc	I2s:	120	220	mAdc
F-4	Life Test:	Group B	t:	500	---	hrs.
F-4b	Life Test End Point:	Operation	Io:	110	---	mAdc

Note 1. In a full-wave circuit adjust Zp/p such that a tube having Etd=60Vdc or 125mAdc per plate gives Io equal to 140 mAdc.

July 31, 1943

THIS SHEET OF TEST LIMITS IS A PART OF SPECIFICATION JAN-1A

Description: Acorn Triode

Ratings Absolute Maximum:	Ef V	Eb Vdc	Ec Vdc	Pp W	Ehk V
	6.3±10%	275	---	1.	90
Test Cond:	6.3	250	-7.0	---	100

*Dimensions: As per outline. **Pin Connections: As per outline

**Cathode: Coated Unipotential

Ref.	Test	Conditions		Min.	Max.
F-6a(2)	*Drop:				
F-5g	*Glass Strain:				
F-6b(1)	*Vibration	Rp=10,000	Ep:	---	200 mVac
F-6i	*Heater Current:		If:	140	160 mA
F-6q	*Insulation:		Ihk:	---	20 uAdc
F-6g(1)	†Grid Current:		Ic:	---	-1.0uAdc
F-6F(1)	Plate Current:		Ib:	3.6	8.6 mADC
F-6F(1)	Plate Current:	Ec=-50 Vdc	Ib:	---	50 uAdc
F-6K	*Plate Resistance:		rp:	8400	14,800ohms
F-6j	Transconductance:		Sm:	1700	2800 umhos
F-6j	*Transconductance:	Ef=5.5V	Sm:	1450	2500 umhos
F-6H(1)	Oscillator Grid Current:	F=600Mc	Ic:	0.2	--- mAdc
F-6e(1)	R-F Noise:	Esig=20MVac			
F-6c(1)	†Emission:	Eb=Ec=15Vdc	Is:	20	--- mAdc
F-6p	*Capacitance:	With Shield	Cgp:	1.0	1.8 uuf
			Cgk:	.70	1.30 uuf
			Cpk:	.3	0.9 uuf
F-4	Life Test:	Group A;Ehk=90Vdc	t:	500	--- hrs.
F-4b	Life Test End Point:	Transconductance	Sm:	1460	--- umhos

July 31, 1943

27-39718

THIS SHEET OF TEST LIMITS FOR TUBE JAN-( )-446-A
IS A PART OF SPECIFICATION JAN. 1 FOR TUBES, RADIO ELECTRON.

Description: U-H-F Triode

Ratings Abs. Max.	Ef V	Eb Vdc	Ec V	Ib mAdc	Pp W	Rk ohms	Seal Temperature	Ehk
Amplifier:	6.3±10%	400	--	20	6.5	--	175°C	100V.
Oscillator:	6.3±10%	400	--	25	6.5	--	175°C	100V.
Test Cond:	6.3	250	0	--	---	200	---	Note 1.

*Dimensions: As per outline *Base: 6-Pin Octal

**Pin No.: 1 2 3 5 7 8 Center Base Cap Washer Shell **Cathode: Coated Unipotential
Element: sh h k k h k p g k(r.f.)

Ref:	Test	Conditions		Min.	Max.	
F-6a(2)	*Drop:					
F-6b(1)	*Vibration:	Ec/Ib=10mAdc;Rp=10,000	Ep:	0	100	mVac
F-6i	*Heater Current		If:	670	830	mA
F-6q	*Insulation:		Ihk:	0	20	uAdc
F-2	Electrode Insulation:		R:	100	---	Meg.
F-6g(1)	Grid Current:		Ic:	0	-1.0	uAdc.
F-6f(1)	Plate Current:		Ib:	8	20	mAdc.
F-6f(1)	*Plate Current:	Ec=-20 Vdc	Ib:	0	100	uAdc
F-6j	Transconductance:		Sm:	3400	5800	umhos
F-6l(1)	*Amplification:		Mu:	35	55	
F-6c(1)	Emission:	Eb=Ec=10Vdc;Rk=0	Is:	40	---	mAdc
F-6p	*Capacitance:	2-3/8" Dia. Shield in plane of grid	Cgk:	1.8	2.6	uuf
			Cpk:	---	0.05	uuf
			Cgp:	1.2	2.0	uuf
			Ck-sh:	20	70	uuf
F-4	Life Test	Eb=300 Vdc; Rk/Ib= 16.5mAdc;Rg=1000	t:	500	---	hrs.
F-4b	Life Test End Point:	Transconductance	Sm:	2500	---	umhos

Note 1. Voltages are measured with respect to ground; cathode is self-biased; Rk by-passed with 1000 uf. A heat conducting radiator is used on the plate cap to limit the Plate temperature.

January 7, 1943 Jan-( )-446-A

TABLE I
LIST OF MAJOR UNITS
FOR MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

QUANTITY 115/1/60-2400	NAVY TYPE DESIGNATION	NAME OF MAJOR UNIT	SYMBOL GROUP	ASSEMBLY DRAWING NUMBER
1	CMD-66AFH	ANTENNA & DETECTOR	101 to 199	FA-1-WJ7
1	CMD-50ADC	AMPLIFIER	201 to 299	FA-2-WJ7
1	CMD-60ABG-1	TEST OSCILLATOR	301 to 399	FA-5-WJ7
1	CMD-10229	RACK	401 to 499	PA-702A
		ACCESSORIES	501 to 599	

TABLE II
PARTS LIST BY SYMBOL DESIGNATION
FOR MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
		STRUCTURAL PARTS					
* A-101	Mounting	Neoprene Gasket			1		4G2A
* A-102	Mounting	Same as A-101					
A-103	Mounting	Antenna Mounting Plate			2	4C137	4C137
A-104	Mounting	Strap			2	4C146	4C146
A-105	Mounting	Fuse Clip			3	S-31-60A-250V	4F1
A-106	Mounting	Fuse Clip			3	#1 AUTO	4F20
* A-401	Shock Mount	8 pound holder type rubber shock absorber			4	150PH8	7S1
* A-402	Shock Mount	Same as A-401					
* A-403	Shock Mount	Same as A-401					
* A-404	Shock Mount	Same as A-401					
		CAPACITORS					
* C-101	V-101 filament bypass	Capacitor, mica, .005 mfd. ±20% 500 V.D.C. working	-481037-B20 CM35B502M	RE48A143G	5	MWBW-1239	4C16
* C-201	R-201 detector bias control bypass	Capacitor, paper, oil filled, .5 mfd. 400 V.D.C. working	-48704	RE48A138H	6		4C18A
* C-202A	V-201 screen bypass	Capacitor, paper, 3 sections, each section 0.1 mfd. 600 V.D.C. working	-48709A	RE48A138H	7	2529-4	4C11
* C-202B	V-201 screen bypass	Same as C-202A					
* C-202C	B+ decoupling capacitor	Same as C-202A					
* C-204	V-201 to V-202 coupling capacitor	Capacitor, molded paper, .005 mfd. 600 V.D.C. working			8	Type DP	4C22
* C-205A	V-202 cathode bypass	Same as C-202A					
* C-205B	V-202 screen bypass	Same as C-202A					
* C-205C	V-202 B+ decoupling capacitor	Same as C-202A					
* C-207	V-202 to V-203 coupling capacitor	Same as C-204					
* C-208A	V-203 cathode bypass	Same as C-202A					
* C-208B	V-203 screen bypass	Same as C-202A					
* C-208C	Video amplifier filament bypass	Same as C-202A					
* C-210A	V-204 B+decoupling capacitor	Capacitor, paper, two sections, each section 0.1 mfd 400 V.D.C. working	-48678	RE48A128J	6		4C17A
* C-210B	V-204 common cathode bypass	Same as C-210A					
* C-211	V-204 pulse sharpening capacitor	Capacitor, ceramic, 50 mmfd. ±5 mmfd, 500 V.D.C.			9	N750K-50±5	4C27
* C-212	V-204 pulse sharpening capacitor	Same as C-211					
* C-215	V-203 to V-204 coupling capacitor	Capacitor, ceramic, 25 mmfd. ±2.5 mfd. 500 V.D.C.	-481197-10		9	N680K-25±2.5	4C2
* C-216	V-203 to V-204 coupling capacitor	Same as C-215					
* C-217	V-204 to V-205 signal coupling capacitor	Same as C-204					
* C-218	Coupling capacitor	Same as C-204					
* C-219	Audio Output coupling capacitor	Capacitor, paper, .5 mfd. 600 V.D.C. working	-481002	RE48A128J	6		4C26

* Spare parts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
* C-220	V-204 to V-206 coupling capacitor	Capacitor, ceramic, 7-45 mmfd. variable, 500 V.D.C. .0005 mmfd./mmfd./°C temp. coeff.	-481623		9	N500TS2A	4C25
* C-221	150 volts B+ bypass	Capacitor,paper,4 mfd.600 V.D.C.working	-481054	RE48A207B	10	TLA6040	4C8
* C-223	High B+ filter,third section	Same as C-221					
* C-224	High B+ filter,second section	Same as C-221					
* C-225	High B+ filter, input	Same as C-221					
* C-226A	Power input line bypass capacitor	Same as C-210A					
* C-226B	Power input line bypass capacitor	Same as C-210A					
* C-227	V-201 Cathode bypass	Capacitor,molded paper,.02mfd.±30%,15V.O.C.W.			8	Type DP	4C28
* C-301	Modulation coupling capacitor	Same as C-215					
* C-302	Multivibrator coupling capacitor	Capacitor, ceramic, 100 mmfd. ±10% 500 V.D.C.	-481959-10		9	N750L-100±10	4C3
* C-303	Pulse rate determining capacitor	Capacitor,mica,200mmfd.±20% 500 V.D.C. working	-48675-20 CM20A201M	RE48A148D	5	MO-1418	4C4A
* C-304	Pulse rate determining capacitor	Capacitor,mica,500 mmfd.±20% 500 V.D.C. working	-48691-20 CM20A501M	RE48A148D	5	MO-1422	4C5A
* C-305	V-301 filament bypass	Same as C-302					
* C-306	V-301 filament bypass	Capacitor, button mica, 500 mmfd. ±5% 500 V.D.C.			9	370A	4C23
* C-307	Oscillator circuit B+ isolating capacitor	Capacitor, mica, unmolded, 100 mmfd. with foil leads			11	Style 80390	4C7
* C-308	Pulse rate determining capacitor	Capacitor, paper 0.1 mfd. 600 V.D.C.	-481001	RE48A128J	7	#2527-12	4C10
* C-309	B+ feed through bushing and R.F. bypass capacitor	Capacitor, ceramic, 55 mmfd. ±10% Temp-coeff. .0004 mmfd/°C 600 V.D.C. working			9	817	4C24
		MISCELLANEOUS ELECTRICAL PARTS					
* E-101	Connector	Grid-Plate connector			2	4C91A	4C91A
* E-102	Pointer and shorting bar	Sliding indicator			2	PA10	PA10
E-102A		Line Connector			2	4C76	4C76
E-102B		Ring small			2	4C131	4C131
E-102C		Pointer			2	4C99	4C99
E-102D		Outer slider			2	4C135	4C135
E-102E		Lock washer			32	#4	4L9
E-102F		Ring large			2	4C134A	4C134A
E-102G		Shorting rod			2	4C85	4C85
E-102H		4-40 x 3/8 screw			33		4S53
E-103	Center conductor	Inner conductor of coaxial tuner			2	4C72	4C72
E-104	Short antenna	Short antenna			2	PA11	PA11
E-105	Medium antenna	Medium antenna			2	PA18-1	PA18-1
E-106	Long antenna	Long antenna			2	PA18-2	PA18-2
* E-107	Connector	Plate connector			2	4C80	4C80
E-108	Outer conductor	Outer conductor of coaxial tuner			2	PA5	PA5
E-109	Contactor	Contact band			2	4C89A	4C89A
* E-201	B+feed through bushing	Threaded polystyrene feed through bushing ¼-28 thread			12	TPB	4B3
* E-202	B+ feed through bushing	Same as E-201					
* E-203	B+ feed through bushing	Same as E-201					
* E-204	Signal feed through bushing	Same as E-201					

* Spare parts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
* E-205	Proximity control knob	Skirt knob, phenolic body with one white line as pointer, 1½" dia. to fit ¼" shaft.			13	S-380-64-B-BB-L	4K3-1
* E-206	Audio gain control knob	Same as E-205					
* E-301	Panel retaining nut	Floating right angle nut, 8-32 thread, steel, cadmium plated base, alum. alloy, anodized nut.			14	F8D832SA	4B4
* E-302	Panel retaining nut	Same as E-301					
* E-303	Pulse rate selector knob	Bar knob, brass pointer, N.P., phenolic body, to fit ¼" shaft			12	HRP-P	4K1
* E-304	Radiator rod	Radiator rod for test oscillator			2	PA128	PA128
E-304A		Rod			2	4C105	4C105
E-304B		Cap			2	4C109	4C109
E-304C		4-40 nut, brass, cadmium plated			34		4N2
* E-305	Radiator and pickup loop	Radiator and pick up loop.			2	PA127A	PA127A
E-305A		Split rod			2	4C106	4C106
E-305B		Tube			2	4C107	4C107
E-305C		Insulator tube			2	4C108	4C108
E-305D		Washer			2	4C110	4C110
E-305E		U rod			2	4C111	4C111
E-305F		Rod			2	4C105	4C105
E-305G		Cap			2	4C109	4C109
E-305H		Nut 4-40, brass, cad. plated			34		4N2
* E-306	Line support	Line support			2	PA150	PA150
E-306A		Insert, brass			2	4I1	4I1
E-306B		Line support, styramic 3/8" thick			2	4S23B	4S23B
		FUSES					
* F-201	Power line fuse	Fuse, 2 amp. 250 volts, overall length 1 ¼", dia. ¼"			15	3AG-2	4F5
* F-202	Power line spare fuse	Same as F-201					
		HARDWARE					
H-101	Locking device	Locking nut for sliding scale			2	4C101	4C101
* H-102	Spacer	Tube socket spacer for short tube(-446)			2	4C81-1	4C81-1
* H-103	Spacer	Same as H-102					
H-104	Spacer	Tube socket spacer for long tube (-446A)			2	4C81-2	4C81-2
H-105	Spacer	Same as H-104					
* H-107	Fastener	Stud			16	99862-2-140	4F6
* H-108	Fastener	Same as H-107					
* H-109	Fastener	Cross pin			16	99785-2	4F14
* H-110	Fastener	Same as H-109					
* H-111	Fastener	Bracket and receptacle			2	PA-16	PA-16
H-111A		Bracket			2	4C133	4C133
H-111B		Receptacle			16	99871-P.098	4F7
H-111C		Rivet .088 x 1/8			35		4R63
* H-113	Mounting	Mounting bar and nuts			2	PA17	PA17
H-113A		Mounting bar			2	4C145	4C145
H-113B		Nut			40	22C6-82	4N25
* H-114		Same as H-113					

* Spare parts furnished. For quantities refer to Table IV

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
H-114A		Same as H-113A					
H-114B		Same as H-113B					
H-115	Support	Support block, zinc casting			2	4C83	4C83
* H-201	V-207 mounting	Eye bracket, steel, cadmium plated, 8-32 thread.			17	CTWS	4B5
* H-202	V-207 mounting	Same as H-201					
* H-203	V-204 hold down	Tube hold down 1.3" inside clearance			18	8596	4H1
* H-204	V-205 hold down	Same as H-203					
* H-205	V-206 hold down	Same as H-203					
* H-206	V-209 hold down	Same as H-203					
* H-207	V-208 hold down	Tube hold down VR type 1.203"clearance			18	8590	4H2
* H-208	Set screw wrench for E-205 & E-206	#10 Allen wrench			19	#10	4T21
* H-209	Plug button	Plug button to conceal shaft of control			18	51007	4B11
H-210	Fastener	Stud, 1" Airlock Wing type			16	99835-1-090	7F1
H-211	Fastener	Pin, Airlock			16	99836	7F2
H-212	Fastener	Receptacle, 1" Airlock			16	99833-C-130	7F3
* H-301	V-302 hold down	Same as H-203					
* H-302	Panel retaining	Captive screw knurled head, black nickel plated, 8-32 thread.			20	AM29-30	4S62
* H-303	Panel retaining	Same as H-302					
* H-304	Set screw wrench for E-303	#8 Allen Wrench			19	#8	4T20
		JACKS AND RECEPTACLES					
* J-101	"A" Supply input	2 circuit type AN connector (female)	AN3102-12S-3S -49194	AN9534 RE49F167D	17 21	AN3102-12S-3S 7130	4S30 4S100
* J-102	Signal output	1 circuit coaxial connector					
* J-201	Signal input	Same as J-102					
* J-202	Power input	3 circuit type AN connector (male)	AN3102-14S -7P		17	AN3102-14S-7P	4S25
* J-203	"A" Supply output	2 circuit type AN connector (female)	AN3102-14S -9S		17	AN3102-14S-9S	4S26
* J-204	Test oscillator power output	Socket, 4 circuit (female)			22	S304AB	4S12
* J-205	Phone Jack	Telephone Jack, single circuit			20	JK34A-J300	4S18
* J-301	Test oscillator power input	Same as J-204					
		INDUCTORS					
* L-201	Filter choke	Reactor, 10 henries at 50 Ma. D.C., resistance approximately 325 ohms.			24	8439	7C31-1
* L-301	V-301 heater R.F. Choke	R.F. choke, 5 turns #16 ga. silver plated copper wire 5/16" I.D., 10 turns per inch.			2	4830	4C30
* L-302	V-301 heater R. F. Choke	Same as L-301					
		METERS					
* M-201	Pulse rate indicator	Milliameter D.C., single scale, calibrated in C.P.S. 0 to 8000, flush mounting type, phenolic case, depth case 1-5/32" behind flange +11/16x1/4-32 studs. Full scale deflection 1 Ma. D.C., resistance 57.2 ohms.	MR25W109SPEC		23	0X33	7M20-1

* Spare parts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
		NAME PLATES, DIALS, CHARTS, ETC.					
N-101	Direct reading tuning scale	Sliding scale calibrated in frequency			2	PA9	PA9
N-101A		Sliding scale			2	4C94C	4C94C
N-101B		Hook			2	4C102A	4C102A
N-101C		Rivet 1/8 by 1/4			35		4R65
N-102	Tuning scale	Frame calibrated in centimeters			2	4C69C	4C69C
		PLUGS					
* P-501	Signal cable connector	1 circuit coaxial plug	-49195	RE49F167D	21	7131	4P14
* P-502	Antenna filament cable connector	2 circuit AN plug (male) with clamp	AN3108-14S-9P		17	AN3108-14S-9P	4P22
* P-503	Power supply cable connector	3 circuit AN plug (female) with clamp	AN3108-14S-7S		17	AN3108-14S-7S	4P21
* P-504	Antenna filament cable connector	2 circuit AN plug (male)	AN3108-12S-3P	AN9534	17	AN3108-12S-3P	4P10
* P-505	Signal cable connector	Same as P-501					
* P-506	Test oscillator supply plug	Plug, 4 circuit (male)			22	P-304-CCT	4P1
* P-507	Test oscillator supply plug	Same as P-506					
* P-508	Headphone plug	2 circuit headphone plug	NAF1136-1			P-166	4P9
* P-509	Part of P-501	Right angle adapter for P-501			21		4P15
* P-510	Part of P-505	Same as P-509					
		RESISTORS					
* R-201	V-101 Bias Control	Potentiometer, wire wound, 10000 ohms, 3 watt, linear taper type 2 shaft, 5/8" long, screw driver slot in shaft		RE13A492C	25	S21-010-072	4R15A
* R-202	T-201 secondary shunting resistor	Resistor, composition, 10000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R17
* R-203	V-201 self bias resistor	Resistor, composition, 180 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R18
* R-204	V-201 screen voltage decoupling	Same as R-202					
* R-205	V-201 plate resistor	Resistor, composition 27000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R20
* R-206	V-202 grid resistor	Resistor, composition, 270000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R22
* R-207	V-202 self bias resistor	Resistor, composition, 220 ohms, ±10% ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R23
* R-208	V-202 screen voltage decoupling	Same as R-202					
* R-209	V-202 Plate resistor	Same as R-205					
* R-210	V-203 grid resistor	Same as R-206					
* R-211	V-203 self bias resistor	Resistor, composition, 2200 ohm, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R21
* R-212	V-203 plate resistor	Resistor, composition, 15000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R33
* R-213	V-203 screen dropping resistor	Resistor, composition, 33000 ohms, ±10% ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R49

** In ordering replacements by this type number it is necessary to state resistance value.

* Spare parts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
* R-214	V-204 B+ Decoupling resistor	Same as R-211					
* R-215	V-204 plate resistor	Resistor, composition 56000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R29
* R-216	V-204 plate resistor	Resistor, composition, 47000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R30
* R-217	V-204 grid plate resistor	Resistor, composition, 560000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R28
* R-218	V-204 grid plate resistor	Same as R-217					
* R-219	V-204 plate resistor	Same as R-202					
* R-220	V-204 grid resistor	Same as R-206					
* R-221	V-204 grid resistor	Same as R-206					
* R-222	Trigger circuit balancing resistor	Potentiometer, composition, 10000 ohms, linear taper, shaft 3/4" long, screw driver slot in shaft			26	Type J-U1031 CR	4R52
* R-223	V-204 bias bleeder resistor	Resistor, composition, 68000 ohms, ±10%, 1 watt, pigtail leads	-63288**	RE13A340C	9	Type 518	4R55
* R-224	V-204 common bias resistor	Resistor, Composition, 6800 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R38
* R-225	Trigger circuit sensitivity control	Same as R-222					
* R-226	V-207 plate resistor	Resistor, composition, 1.0 megohm, ±20%. ½ watt, pigtail leads. Replace by Navy Type -63360**		RE13A340C	9	Type 504	4R6
* R-227	V-205 bias resistor	Resistor, composition, 1500 ohms, ±10% ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R48
* R-228	V-205 plate resistor	Resistor, composition, 470,000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R35
* R-229		Resistor, composition, 20 megohm, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R53
* R-230	V-207 grid resistor	Resistor, composition, 3.3 megohm, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R4
* R-231	Audio volume control	Potentiometer, wire wound, 10000 ohms, 3 watt, linear taper, shaft 3/4" long		RE13A492C	27	P58-10000	4R51
* R-232	V-206 grid resistor	Resistor, composition, 680000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R54
* R-233	V-206 self bias resistor	Same as R-227					
* R-234	V-206 plate resistor	Same as R-228					
* R-235	Counter circuit calibration control	Same as R-222					
* R-236	V-206 bias bleeder resistor	Resistor, composition, 22000 ohms, ±10%, 1 watt, pigtail leads	-63288**	RE13A340C	9	Type 518	4R37
* R-237	Proximity control	Potentiometer, wire wound, 75000 ohms, 3 watts, linear taper, shaft 1" long	-631361	RE13A492C	27	P58-75000	4R12B
* R-238	Pulse amplifier screen bleeder	Resistor, composition, 100000 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R39
* R-239	V-202 plate decoupling resistor	Same as R-211					
* R-240	Pulse amplifier B+ decoupling resistor	Same as R-211					
* R-241	Pulse amplifier B+ decoupling resistor	Resistor, composition, 4700 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R40
* R-242	V-206 fixed self bias resistor	Resistor, composition, 3300 ohms, ±10%, ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R50

** In ordering replacements by this type number it is necessary to state resistance value.

* Spareparts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
* R-243	V-208 dropping resistor	Resistor, wire wound, 4400 ohms, ±5%, 5 watt, pigtail leads			7	5NI	4R56
* R-244	V-205 grid resistor	Same as R-229					
* R-301	Pulse rate determining resistor	Resistor, Composition, 15 megohm, ±10% ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R1
* R-303	Pulse rate determining resistor	Resistor, Composition, 6.8 megohm, ±10% ½ watt, pigtail leads	-63360**	RE13A340C	9	Type 504	4R2
* R-304	Pulse rate determining resistor	Same as R-230					
* R-305	V-301 B+ decoupling resistor	Resistor, composition, 8200 ohm, ± 20% ½ watt, pigtail leads. Replace with Navy type -63360**		RE13A340C	9	Type 504	4R5
* R-306	V-301 grid resistor	Same as R-305					
* R-307	V-302 grid resistor	Same as R-226					
* R-308	V-302 plate resistor	Resistor, composition 22000 ohms, ± 20%, ½ watt, pigtail leads. Replace with Navy type -63360**		RE13A340C	9	Type 504	4R7
* R-309	V-302 plate resistor	Same as R-308					
* R-310	B + decoupling resistor	Resistor, composition, 1000 ohms, ± 20%, ½ watt, pigtail leads. Replace with Navy type -63360**		RE13A340C	9	Type 504	4R8
		SWITCHES					
* S-201	Power ON-OFF switch	Toggle switch, D.P.S.T., bat handle, 3 amp. 125 volts	-24001	RE24AA118A	28	IGA2A21	4S4
* S-301	Pulse rate selector switch	Rotary type switch, double pole, 4 position, non-shorting contacts			29	24602-HIC	4S1
		TRANSFORMERS					
* T-201	Input transformer	Pulse transformer, primary : 50 turns #35 SSE wire, secondary: 375 turns #35 SSE wire, core material: moly permalloy.		RE13A554D	2	4T11	4T11
T-201A		Paper collar			2	4C21	4C21
T-201B		#6 external lockwasher			36	1106	4L1
T-201C		Solder lug			37		4L11
T-201D		Round solder lug			39	RA62A239A	4L13
T-201E		#6 plain washer			33	5708 B	4L17
T-201F		6-32 nut			38		4N1
T-201G		Support			2	4S29	4S29
T-201H		4-40 x 1/4 F. H.			34		4S57
T-201I		6-32 x 1 1/8			33		4S74
T-201J		Mounting board			2	4T9	4T9
T-201K		"L" cores			2	4T12	4T12
T-201L		#35 SSE wire			30	#35SSE	4W16
* T-202	Power transformer	Power transformer, primary 110V.A.C.,60 to 2400 cycles, secondary #1-480 volts with center tap to deliver .050 amperes rectified with 4 mfd. condenser input filter, secondary #2 - 6.3 volts at 3.5 amperes, secondary #3-5.0 volts at 2.0 amperes.			24	8399	4T10-1

** In ordering replacements by this type number it is necessary to state resistance value.
* Spare parts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
		VACUUM TUBES (for complete electrical characteristics see Page 54).					
* V-101	Detector	Vacuum tube, (receiving triode) glass, base #6527	-446A		28	GL-446A	4U7
* V-201	First video amplifier	Vacuum tube (receiving pentode) metal, standard octal base, 6.3 volts at 0.45 amp.	-6AC7	JAN-1A	11	6AC7	4U5
* V-202	2nd. pulse amplifier	Same as V-201					
* V-203	3rd. pulse amplifier	Same as V-201					
* V-204	trigger circuit	Vacuum tube, (receiving-dual triode) glass, standard octal base, 6.3 volts at 0.3 amp.	-6SL7GT	JAN-1A	11	6SL7GT	4U6
* V-205	Audio amplifier	Vacuum tube (receiving-dual triode) glass, standard octal base, 6.3 volts at 0.6 amp.	-6SN7GT	JAN-1A	11	6SN7GT	4U9
* V-206	Frequency counter	Same as V-205					
* V-207	Visual signal indicator	Vacuum tube, (receiving-triode) with electron ray indicator) glass, small 6 pin base, 6.3 volts at 0.3 amp.	-6E5	JAN-1A	11	6E5	4U10
* V-208	Voltage regulator	Vacuum tube (voltage regulator) glass, small shell octal, 6 pin base, 180 D.C. volts starting supply, operating voltage 150DC, operating current 5 ma. to 30 ma. D.C.	-VR150-30	JAN-1A	11	VR150-30	4U12
* V-209	Rectifier	Vacuum tube (full wave rectifier) glass, standard octal base, 5 volts at 2.0 amp.	-5Y3GT		11	5Y3GT	4U11
* V-301	Oscillator	Vacuum tube, glass, acorn type, 6.3 volts at 0.15 amp. 5 prong.	-955	JAN-1A	11	955	4U1
* V-302	Modulator	Same as V-204					
		CABLES					
* W-501	Output cable	Coaxial cable, 50 ohm characteristic impedence	CASSF50-1	C-48-107	17		4W9A
W-502	Antenna filament supply cable	2 conductor shielded cable, both conductors #14 gauge		C-48-212	30		4W7
W-503	Test oscillator power supply	3 conductor shielded cable, all conductors #14 gauge.		C-48-302	41		4W8
W-504	AC power cable	Same as W-502					

* Spare parts furnished. For quantities refer to Table IV.

TABLE II (Con'd)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DRAW. OR SPEC.	MFG.	MFG. DESIG.	MIDWEST PART NO.
		SOCKETS					
* X-101	Detector socket	Vacuum tube socket, standard receiving octal, wafer type, ceramic base material		RE13A554D	18	#115001-6	4S9
* X-201	V-201 tube socket	Vacuum tube socket, standard receiving octal, wafer type, phenolic base material	-49374	RE49AA312A	18	9864	4S11
* X-202	V-202 tube socket	Same as X-201					
* X-203	V-203 tube socket	Same as X-201					
* X-204	V-204 tube socket	Same as X-201					
* X-205	V-205 tube socket	Same as X-201					
* X-206	V-206 tube socket	Same as X-201					
* X-207	V-208 tube socket	Same as X-201					
* X-208	V-209 tube socket	Same as X-201					
* X-209	V-207 tube socket	Vacuum tube socket, standard 6 prong, molded phenolic base, metal shield cap	-49348	RE49AA313A	17	PF6-7	4S19
* X-210	Fuse holder	Fuse holder, phenolic body, bayonet type to hold type 3AG fuse			15	HCM	4F10
* X-211	Fuse holder	Same as X-210					
* X-301	V-301 tube socket	Acorn type tube socket, wafer type, ceramic base			31	62-A5	4S10
* X-302	V-302 tube socket	Same as X-201					

* Spare parts furnished. For quantities refer to Table IV.

TABLE III

PARTS LIST BY NAVY TYPE NUMBERS FOR MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

MISCELLANEOUS CLASS 10

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
1						A-101, A-102
1						A-103
1						A-104
2						A-105
2						A-106
			4			A-401, A-402,
						A-403, A-404
1						E-101
1						E-102
1						E-103
1						E-104
1						E-105
1						E-106
1						E-107
1						E-108
1						E-109
	4					E-201, E-202
						E-203, E-204
	2					E-205, E-206
		2				E-301, E-302
		1				E-303
		1				E-304
		1				E-305
		1				E-306
1						H-101
* 0						H-102, H-103
2						H-104, H-105
2						H-107, H-108
2						H-109, H-110
2						H-111
2						H-113, H-114
1						H-115
	2					H-201, H-202
	4	1				H-203, H-204, H-301
						H-205, H-206
	1					H-207
	1					H-208
	1					H-209
	1					H-210
	1					H-211
	1					H-212
		2				H-302, H-303
		1				H-304
1						N-101
1						N-102
				1	CASSF50-1	W-501
				1		W-502
				1		W-503
				1		W-504

METERS CLASS 22

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	1				MR25W109SPEC	M-201

SWITCHES CLASS 24

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	1				-24001	S-201
		1				S-301

FUSES (CARTRIDGE) CLASS 28

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	2					F-201, F-202

TRANSFORMERS CLASS 30

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	1					T-201
	1					T-202

VACUUM TUBES CLASS 38

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
1					-446A	V-101
	3				-6AC7	V-201, V-202, V-203
	1	1			-6SL7GT	V-204, V-302
	2				-6SN7GT	V-205, V-206
	1				-6E5	V-207
	1				-VR150-30	V-208
	1				-5Y3GT	V-209
		1			-955	V-301

INDUCTORS (R.F. CHOKES) CLASS 47

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	1					L-201
		2				L-301, L-302

CAPACITORS CLASS 48

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
1					-481037-B20	C-101
	1				-48704	C-201
	3				-48709A	C-202, C-205, C-208
	4					C-204, C-207, C-217, C-218
	2				-48678	C-210, C-226
						C-211, C-212
	2	1			-481197-10	C-215, C-216 C-301

CAPACITORS (CONT.) CLASS 48

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	1					C-227
	1				-481002	C-219
	1				-481623	C-220
	4				-481054	C-221, C-223, C-224, C-225
		2			-481959-10	C-302, C-305
		1			-48675-20	C-303
		1			-48691-20	C-304
		1				C-306
		1				C-307
		1			-481001	C-308
		1				C-309

JACKS, PLUGS, SOCKETS CLASS 49

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
1					AN3102-12S-3S	J-101
1	1				-49194	J-102, C-201
	1				AN3102-14S-7P	J-202
	1				AN3102-14S-9S	J-203
	1	1				J-204, J-301
	1					J-205
				2	-49195	P-501, P-505
				1	AN3108-14S-9P	P-502
				1	AN3108-14S-7S	P-503
				1	AN3108-12S-3P	P-504
				2		P-506, P-507
				1	NAF1136-1	P-508
				2		P-509, P-510
1						X-101
	8	1			-49374	X-201, X-202, X-203, X-204, X-205, X-206 X-207, X-208, X-302
	1				-49348	X-209
	2					X-210, X-211
		1				X-301

RESISTORS CLASS 63

Quantity CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	1					R-201
	4				-63360**	R-202, R-204 R-208, R-219
			1		-63360**	R-203
			2		-63360**	R-205, R-209
			4		-63360**	R-206, R-210 R-220, R-221
			1		-63360**	R-207
			4		-63360**	R-211, R-214 R-239, R-240

* Included in spare parts for short tube.

TABLE III (Cont'd)

Quantity					NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
CMD-66AFH	CMD-50ADC	CMD-60ABG-1	CMD-10229	Accessories		
			RESISTORS CLASS 63			
	1				-63360**	R-212
	1				-63360**	R-213
	1				-63360**	R-215
	1				-63360**	R-216
	2				-63360**	R-217, R-218
	3				-63360**	R-222, R-225
						R-235
	1				-63288**	R-223
	1				-63360**	R-224
	1	1			-63360**	R-226, R-307
	2				-63360**	R-227, R-233
	2				-63360**	R-228, R-234
	1				-63360**	R-244
	1	1			-63360**	R-230, R-304
	1					R-231
	1				-63360**	R-232
	1				-63288**	R-236
	1				-631631	R-237
	1				-63360**	R-238
	1				-63360**	R-241
	1				-63360**	R-242
	1					R-243
		1			-63360**	R-301
		1			-63360**	R-303
		2				R-305, R-306
		2				R-308, R-309
		1				R-310

** In ordering replacements by this type number it is necessary to state resistance value.

TABLE IV
SPARE PARTS LIST BY NAVY TYPE DESIGNATION FOR
MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFG.	MFR. DESIG.	MIDWEST PART NUMBER
				MISCELLANEOUS (CLASS 10)				
2			A-101, A-102	Neoprene Gasket		1		4G2A
1	4		A-401, A-402, A-403 A-404	8 pound holder type rubber shock absorber		4	150PH8	7S1
2			E-101	Grid-Plate connector		2	4C91A	4C91A
1			E-102	Sliding indicator and tuning piston		2	PA10	PA10
2			E-107	Plate Connector		2	4C80	4C80
	4		E-201, E-202, E-203 E-204	Threaded polystyrene feed through bushing $\frac{1}{4}$-28 thread		12	TBP	4B3
2			E-205, E-206	Skirt knob, phenolic body with one white line as pointer, $1\frac{1}{2}$" dia. to fit $\frac{1}{4}$" shaft		13	S-380-64-B-BB-L	4K3-1
	4		E-301, E-302	Floating right angle nut, 8-32 thread, steel cadmium plated base, alum. alloy, anodized nut.		14	F8D32SA	4B4
1			E-303	Bar knob, brass pointer, N.P., phenolic body, to fit $\frac{1}{4}$" shaft		12	HRP-P	4K1
1			E-304	Radiator rod for test oscillator		2	PA128	PA128
	1		E-305	Radiator and pick up loop.		2	PA127A	PA127A
	1		E-306	Line Support		2	PA150	PA150
2			H-102, H-103	Tube socket spacer for short tube (-446)		2	4C81-1	4C81-1
2			H-107, H-108	Stud		16	99862-2-140	4F6
2			H-109, H-110	Cross pin		16	99785-2	4F14
2			H-111	Bracket and Receptacle		2	PA-16	PA-16
2			H-113, H-114	Mounting bar and nuts		2	PA17	PA17
	2		H-201, H-202	Eye bracket, steel, cadmium plated, 8-32 thread.		17	CTWS	4B5
	5		H-203, H-204, H-205 H-206, H-301	Tube hold down 1.3" inside clearance		18	8596	4H1
	1		H-207	Tube hold down VR type 1.203" clearance		18	8590	4H2
1	2		H-208	#10 Allen wrench		19	#10	4T21
1			H-209	Plug button to conceal shaft of control		18	51007	4B11
	4		H-302, H-303	Captive screw knurled head, black nickel plated 8-32 thread.		20	AM29-30	4S62
1	2		H-304	#8 Allen Wrench		19	#8	4T20
				METERS (CLASS 22)				
	4	MR25W109SPEC	M-201	Milliameter D.C., single scale, calibrated in C.P.S. 0 to 8000, flush mounting type, phenolic case 1-5/32" behind flange 11/16 x 1/4-32 studs. full scale deflection 1 Ma. D.C., resistance 57.2 ohms		23	0X33	7M20-1
				SWITCHES (CLASS 24)				
1	2	-24001	S-201	Toggle switch, D.P.S.T., bat handle, 3 amp.125 volts	RE24AA118A	28	IGA2A21	4S4
1	1		S-301	Rotary type switch, double pole, 4 position, non-shorting contacts		29	24602-HIC	4S1

TABLE IV (Cont'd)

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
				FUSES (CLASS 28)				
10	50		F-201, F-202	Fuse, 2 amp. 250 volts, overall length 1¼" dia. ¼"		15	3AG-2	4F5
				TRANSFORMERS (CLASS 30)				
1	1		T-201	Pulse transformer, primary: 50 turns #35 SSE wire, secondary: 375 turns #35 SSE wire, core material: moly permalloy	RE13A554D	2	4T11	4T11
	2		T-202	Power transformer, primary 110V. A.C., 60 to 2400 cycles, secondary #1-480 volts with center tap to deliver .050 amperes rectified with 4 mfd. condenser input filter, secondary #2 - 6.3 volts at 3.5 amperes, secondary #3-5 volts at 2.0 amperes		24	8399	7T10-1
				VACUUM TUBES (CLASS 38)				
2		-446A	V-101	Vacuum tube, (receiving triode) glass, base #6527			GL-446-A	4U7
6		-6AC7	V-201, V-202, V-203	Vacuum tube (receiving pentode) metal, standard octal base, 6.3 volts at 0.45 amp.	JAN-1A	11	6AC7	4U5
4		-6SL7GT	V-204, V-302	Vacuum tube,(receiving-dual triode) glass, standard octal base, 6.3 volts at 0.3 amp.	JAN-1A	11	6SL7GT	4U6
4		-6SN7GT	V-205, V-206	Vacuum tube (receiving-dual triode) glass, standard octal base 6.3 volts at 0.6 amp.	JAN-1A	11	6SN6GT	4U9
2		-6E5	V-207	Vacuum tube, (receiving-triode with electron ray indicator) glass, small 6 pin base, 6.3 volts at 0.3 amp	JAN-1A	11	6E5	4U10
2		-VR150-30	V-208	Vacuum tube (Voltage regulator) glass, small shell octal, 6 pin base, 180 D.C. volts starting supply, operating voltage 150 DC, operating current 5ma. to 30 ma. D.C.	JAN-1A	11	VR150-30	4U12
2		-5Y3GT	V-209	Vacuum tube (full wave rectifier) glass, standard octal base, 5 volts at 2.0 amp.		11	5Y3GT	4U11
2		-955	V-301	Vacuum tube, glass, acorn type, 6.3 volts at 0.15 amp. 5 prong.	JAN-1A	11	955	4U1
				INDUCTORS-R.F. CHOKES (CLASS 47)				
	2		L-201	Reactor, 10 Henries at 50Ma. D.C., resistance approximately 325 ohms.		24	8439	7C31-1
1	2		L-301, L-302	R. F. choke, 5 turns #16 ga. tinned copper wire 5/16" I.D., 10 turns per inch.		2	4C30	4C30

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
				CAPACITORS (CLASS 48)				
1		-481037-B20	C-101	Capacitor, mica, .005 mfd. ± 20% 500 V.D.C. working	RE48A143G	5	MWBW-1239	4C16
1	3	-48704	C-201	Capacitor, paper, oil filled, .5 mfd. 400 V.D.C. working	RE48A138H	6		4C18A
2	8	-48709A	C-202, C-205, C-208	Capacitor, paper, 3 sections, each section 0.1 mfd. 600 V.D.C. working	RE48A138H	7	2529-4	4C11
2	10		C-204, C-207, C-217 C-218	Capacitor, molded paper, .005 mfd. 600 V.D.C. working		8	Type DP	4C22
1	5	-48678	C-210, C-226	Capacitor, paper, two section, each section 0.1 mfd 400 V.D.C. working	RE48A128J	6		4C17A
1	5		C-211, C-212	Capacitor, ceramic, 50 mmfd. ± 5 mmfd, 500 V.D.C.		9	N750K-50±5	4C27
2	8	-481197-10	C-215, C-216, C-301	Capacitor, ceramic, 25 mmfd ± 2.5 mmfd 500 V.D.C.		9	N680K-25 ±2.5	4C2
1	3	-481002	C-219	Capacitor, paper, 0.5 mfd. 600 V.D.C. working	RE48A128J	6		4C26
1	5	-481623	C-220	Capacitor, ceramic, 7-45mmfd. variable, 500 V.D.C. .0005 mmfd./mmfd./°C temp. coeff.		9	N500TS2A	4C25
2	10	-481054	C-221, C-223, C-224 C-225	Capacitor, paper, 4 mfd. 600 V.D.C. working	RE48A207B	10	TLA6040	4C8
1	5		C-302, C-305	Capacitor, ceramic 100mmfd. ± 10% 500 V.D.C.		9	N750L-100 ±10	4C3
1	1	-48675-20 CM20A201M	C-303	Capacitor, mica 200mmfd. ±20% 500 V.D.C. working	RE48A148D	5	MO-1418	4C4A
1	1	-48691-20 CM20A501M	C-304	Capacitor, mica, 500mmfd. 20% 500 V.D.C. working	RE48A148D	5	MO-1422	4C5A
1	5		C-306	Capacitor, button mica, 500 mmfd. ±5% 500 V.D.C.		9	370A	4C23
1	1		C-307	Capacitor, mica, unmolded, 100 mmfd with foil leads		11	Style 80390	4C7
1	3	-481001	C-308	Capacitor, paper 0.1 mfd. 600 V.D.C.	RE48A128J	7	#2527-12	4C10
1	5		C-309	Capacitor, ceramic 55mmfd. ±10%, Temp-coeff, .0004 mmfd/°C 600 V.D.C. working		9	817	4C24
1	3		C-227	Capacitor, paper, .02 mfd., ± 30%, 15 V.D.C.W		8	Type DP	4C28
				JACKS, PLUGS, & SOCKETS (CLASS 49)				
1		AN3108-12S-3S	J-101	2 circuit type AN connector (female)	AN9534	17	AN3102-12S 3S	4S30
1	1	-49194	J-102, J-201	1 circuit coaxial connector	RE49F167D	21	7130	4S100
	1	AN3102-14S -7P	J-202	3 circuit type AN connector (male)		17	AN3102-14S-7P	4S25
	1	AN3102-14S -9S	J-203	2 circuit type AN connector (female)		17	AN3102-14S -9S	4S26
	1		J-204, J-301	Socket, 4 circuit (female)		22	S304AB	4S12
	1		J-205	Telephone Jack, single circuit		22	JK34A-J300	4S18
2	2	-49195	P-501, P-505	1 circuit coaxial plug	RE49F167D	21	7131	4P14
1	2	AN3108-14S-9P	P-502	2 circuit AN plug (male) with clamp		17	AN3108-14 S-9P	4P22
1	2	AN3108-14S-7S	P-503	3 circuit AN plug (female) with clamp		17	AN3108-14S-7S	4P21

TABLE IV (Cont'd)

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
				JACKS, PLUGS, & SOCKETS (Cont'd)				
1		AN3108-12S 13P	P-504	2 circuit AN plug (male)	AN9534	17	AN3108-12S-3P	4P10
2	2		P-506, P-507	Plug, 4 circuit (male)		22	P-304-CCT	4P1
1	1	NAF1136-1	P-508	2 circuit headphone plug			P-166	4P9
1	2		P-509, P-510	Right angle adapter for P-501		21		4P15
1			X-101	Vacuum tube socket, standard receiving octal, wafer type, ceramic base material	RE13A554D	18	#115001-6	4S9
	1	-49374	X-201, X-202, X-203 X-204, X-205, X-206 X-207, X-208, X-302	Vacuum tube socket, standard receiving octal, wafer type, phenolic base material	RE49AA312A	18	9864	4S11
	1	-49348	X-209	Vacuum tube socket, standard 6 prong, molded phenolic base, metal shield cap	RE49AA313A	17	PF6-7	4S19
	2		X-210, X-211	Fuse Holder, phenolic body, bayonet type to hold type 3AG fuse		15	HCM	4F10
1	2		X-301	Acorn type tube socket, wafer type, ceramic base		31	62-A5	4S10
				RESISTORS (CLASS 63)				
1	5		R-201	Pontentiometer, wire wound, 10000 ohms, 3 watt, linear taper type 2 shaft, 5/8" long, screw driver slot in shaft.	RE13A492C	25	S21-010-072	4R15A
2	10	-63360**	R-202, R-204, R-208 R-219	Resistor, composition, 10000ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R17
1	5	-63360**	R-205, R-209	Resistor, composition 27000 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R20
1	3	-63360**	R-203	Resistor, composition, 180 ohms, ±10%, ½watt, pigtail leads	RE13A340C	9	Type 504	4R18
2	10	-63360**	R-206, R-210, R-220 R-221	Resistor, composition, 270000 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R22
1	3	-63360**	R-207	Resistor, composition, 220 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R23
2	10	-63360**	R-211, R-214, R-239 R-240	Resistor, composition, 2200 ohm, ±10&, ½watt, pigtail lead	RE13A340C	9	Type 504	4R21
1	3	-63360**	R-212	Resistor, composition, 15000 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R33
1	3	-63360**	R-213	Resistor, composition, 33000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R49
1	3	-63360**	R-215	Resistor, composition 56000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R29
1	3	-63360**	R-216	Resistor composition, 47000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R30
1	5	-63360**	R-217, R-218	Resistor composition 560000,ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R28
3	5		R-222, R-225, R-235	Potentiometer, composition, 10000 ohms, linear taper shaft 3/4" long, screw driver slot in shaft.		26	Type J U1031CR	4R52

TABLE IV (Cont'd)

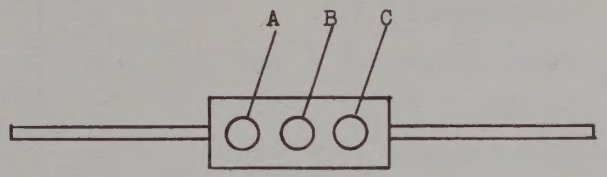
QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED		NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
1	3	-63288**	R-223	Resistor, composition 68000 ohms 10% 1 watt, pigtail leads	RE13A340C	9	Type 518	4R55
1	3	-63360**	R-224	Resistor, composition 6800 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R38
2	8		R-226, R-307	Resistor composition 1.0 megohm, 20% ½ watt, pigtail leads. Replace by Navy-63360**	RE13A340C	9	Type 504	4R6
1	5	-63360**	R-227, R-233	Resistor, composition, 1500 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R48
1	5	-63360**	R-228, R-234	Resistor, composition 470,000 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R35
1	3	-63360**	R-244	Resistor Composition 20 megohm, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R53
1	5	-63360	R-230, R-304	Resistor, composition 3.3 megohm, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R4
1	5		R-231	Potentiometer, wire wound, 10000 ohms, 3 watt, linear taper, shaft 3/4" long	RE13A492C	27	P58-10000	4R51
1	3	-63360**	R-232	Resistor, composition 680000 ohms, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R54
1	3	-63288**	R-236	Resistor, composition, 22000 ohms 10% 1 watt pigtail leads	RE13A340C	9	Type 518	4R37
1	5	-631361	R-237	Potentiometer, wire wound, 75000 ohms, 3 watts, linear taper shaft 1" long	RE13A492C	27	P58-75000	4R12B
1	3	-63360**	R-238	Resistor, composition, 100000 ohms, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R39
I	3	-63360**	R-241	Resistor, composition 4700 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R40
1	3	-63360**	R-242	Resistor, composition 3300 ohms, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R50
1	5		R-243	Resistor, wire wound, 4400 ohms, ±5%, 5watts, pigtail leads		7	5NI	4R56
1	3	-63360**	R-301	Resistor, composition, 15 megohm, ±10%, ½watt, pigtail leads	RE13A340C	9	Type 504	4R1
1	3	-63360**	R-303	Resistor, composition, 6.8megohm, ±10%, ½watt, pigtail leads	RE13A340C	9	Type 504	4R2
1	5		R-305, R-306	Resistor, composition, 8200 ohms, ±20%, ½watt, pigtail leads Replace by Navy -63360**	RE13A340C	9	Type 504	4R5
1	5		R-308, R-309	Resistor, composition, 22000ohms, ±20%, ½watt, pigtail leads Replace by Navy -63360**	RE-13A340C	9	Type 504	4R7
1	3		R-310	Resistor, composition, 1000ohms, ±20%, ½watt, pigtail leads Replace by Navy -63360**	RE13A340C	9	Type 504	4R8

** In ordering replacements by this type number it is necessary to state resistance value.

TABLE V
APPLICABLE COLOR CODES AND MISCELLANEOUS DATA FOR MODEL ARD- 2
AIRCRAFT RADIO RECEIVING EQUIPMENT

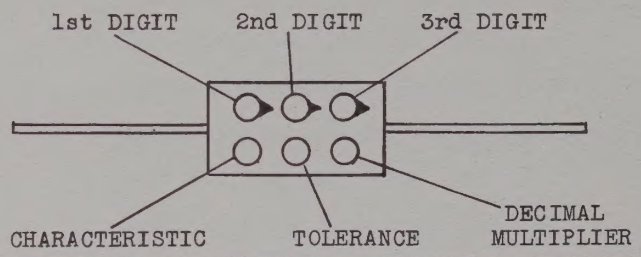
COLOR CODE IN MMFD. FOR CAPACITORS

COLOR	1st DIGIT A	2nd DIGIT B	CIPHERS C
BLACK	0	0	NONE
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
PURPLE	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000



AMERICAN WAR STANDARD COLOR CODE IN MMFD. FOR CAPACITORS

COLOR	1st DIGIT	2nd DIGIT	3rd DIGIT	DECIMAL MULTIPLIER	TOLERANCE	CHARACTERISTIC
BLACK	0	0	0	1		A
BROWN	1	1	1	10		B
RED	2	2	2	100	2%	C
ORANGE	3	3	3	1,000		D
YELLOW	4	4	4			E
GREEN	5	5	5			F
BLUE	6	6	6			G
VIOLET	7	7	7			
GRAY	8	8	8			
WHITE	9	9	9			
GOLD				0.1	5%	
SILVER				0.01	10%	
BLACK					20%	



COLOR CODE IN MMFD. FOR "TOOTHPICK" CAPACITORS

RED 100

STANDARD COLOR CODE IN OHMS FOR RESISTORS

COLOR	1st DIGIT A	2nd DIGIT B	CIPHERS C
BLACK	0	0	NONE
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
PURPLE	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000

TOLERANCE CODE D	%
BLACK or NONE	20
SILVER	10
GOLD	5

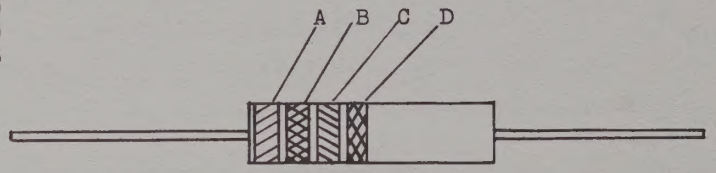


TABLE VI
LIST OF MANUFACTURERS
FOR MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

CODE NUMBER	MFR. PREFIX.	NAME	ADDRESS
1		TOLEDO INDUSTRIAL RUBBER CO.	532-8 ST. CLAIR, TOLEDO, OHIO
2	CMD	MIDWEST RADIO CORP.	909 BROADWAY, CINCINNATI, OHIO
3	CSH	H. B. SHERMAN	1934 SPERY ST., BATTLE CREEK, MICHIGAN
4		LORD MFG. CO.	ERIE, PENNSYLVANIA
5	CSL	SOLAR MFG. CORP.	588 AVENUE A, BAYONNE, NEW JERSEY
6	CAW	AEROVOX WIRELESS CORP.	742 BELLEVILLE AVENUE, NEW BEDFORD, MASS.
7	CSF	SPRAGUE SPECIALTIES CO.	N. ADAMS, MASS.
8	CTD	TOBE-DEUTSCHMANN CORP.	CANTON, MASS.
9	CER	ERIE RESISTOR CORP.	644 W. 12th ST., ERIE, PA.
10	CD	CORNELL-DUBILIER CORP.	1000 HAMILTON BLVD., SOUTH, PLAINFIELD, N.J.
11	CRV	R.C.A. MFG. CO.	POINT & COOPER STS., CAMDEN, NEW JERSEY
12	CNA	NATIONAL COMPANY, INC.	61 SHERMAN ST. MALDEN, MASS.
13		KURZ-KASCH INC.	1423 S. BROADWAY, DAYTON, OHIO
14		BOOTS AIRCRAFT NUT CORP.	NEW CANAAN, CONN.
15	CFA	BUSSMAN MFG. CO.	2538 W. UNIVERSITY ST., ST. LOUIS, MO.
16	CUF	UNITED CARR FASTENER CO.	450 MAIN ST., CAMBRIDGE, MASS.
17	CPH	AMERICAN PHENOLIC CORP.	1250 W. VAN BUREN ST., CHICAGO, ILL.
18	CMG	CINCH MFG. CO.	2339 W. VAN BUREN ST., CHICAGO, ILL.
19		MECHANICAL SUPPLY CO.	VINE & PEARL STS., CINCINNATI, OHIO
20	CTC	CHICAGO TELEPHONE SUPPLY CO.	ELKHART, INDIANA
21	CQA	THE ASTATIC CORP.	830 MARKET ST., YOUNGSTOWN, OHIO
22	CJC	HOWARD B. JONES	2300 W. WABANSIA AVENUE, CHICAGO, ILLINOIS
23	CAY	WESTINGHOUSE ELECTRIC & MFG. CO.	NEWARK WORKS, NEW JERSEY
24	CTR	CHICAGO TRANSFORMER CORP.	3501 ADDISON ST., CHICAGO, ILL.
25	CBN	CENTRAL RADIO LABORATORY	900 E. KEEFE AVENUE, MILWAUKEE, WIS.

TABLE VI (Con'd)

CODE NUMBER	MFR. PREFIX	NAME	ADDRESS
26	CBZ	ALLEN-BRADLEY CO.	118 W. GREENFIELD AVE., MILWAUKEE, WISC.
27	CMC	CLAROSTAT MFG. CO.	285-287 N. 6th ST., BROOKLYN, NEW YORK
28	CG	GENERAL ELECTRIC CO.	SCHNECTADY, NEW YORK
29	COC	OAK MFG. CO.	1200 N. CLYBOURNE AVE., CHICAGO, ILL.
30		ESSEX WIRE CORP.	14312 WOODWARD AVE., DETROIT, MICH.
31		THE FRIEDMAN CO.	220 E. 25th ST., NEW YORK CITY, NEW YORK
32		NATIONAL LOCK WASHER	38 HERMON ST., NEWARK, NEW JERSEY
33		MFG'S SCREW PRODUCTS	250 W. HUBBARD ST., CHICAGO, ILL.
34		GUARANTEE SPECIALTY MFG. CO.	60 LISPENARD ST., NEW YORK, NEW YORK
35		TUBULAR RIVET & STUD	WOLLASTON, MASS.
36		SHAKEPROOF LOCK WASHER	2501 N. KEELER AVE., CHICAGO, ILL.
37		ZIERICK MFG. CORP.	385 GERARD AVE., NEW YORK, NEW YORK
38		UNITED SCREW & BOLT CORP.	3592 W. 58th ST., CLEVELAND, OHIO
39		BLAKE & JOHNSON CO.	1300 THOMASTON AVE., WATERVILLE, CONN.
40		ELASTIC STOP NUT CORP.	2330 VAUXHALL RD., UNION, NEW JERSEY
41		PHELPS DODGE COPPER CORP.	40 WALL STREET, NEW YORK, NEW YORK

SPARE PARTS LIST

for

Model ARD-2
Aircraft Radio Receiving Equipment

Contract NXss — 12756

MIDWEST RADIO CORPORATION, CONTRACTOR
909 Broadway
CINCINNATI, OHIO

ERRATA-MODEL ARD-2 SPARE PARTS LIST

Table IV

Miscellaneous (Class 10)

Line 2 - "150 PHS" should be "150 PH8"
Line 18 - "H-102, H-102" should be "H-102, H-103"

Transformers (Class 30)

Line 4 - "4T10-1" should be 7T10-1"
Line 8 - "secondary #3.5 volts" should be "secondary #3-5 volts."

Inductors - R.F. Chokes (Class 47)

Line 3 - "silver plated" should be "tinned"

Capacitors (Class 48)

Line 27 - "55 mmfd. 10%" should be "55 mmfd. ±10%"

Jacks, Plugs & sockets (Class 49)

Line 6 - "AN2102-14S" should be AN3102-14S"

Resistors (Class 63)

Line 10 - "27000 ohms" should be 270000 ohms"
Line 11 - add R-221
Line 24 - "56000 ohms" should be "560000 ohms"
Line 28 - "69000 ohms" should be "68000 ohms"
Line 32 - Equip spares quantity "1" should be "2"

LINE 48 - REMOVE NAVY TYPE NUMBER - 631631
LINE 49 - "1" " SHOULD BE ¾" "

MISCELLANEOUS (CLASS 10)
LINE 1 - CHANGE "2" IN EQUIP. SPARES TO "1"

TABLE I
LIST OF MAJOR UNITS
FOR MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

QUANTITY 115/1/60-2400	NAVY TYPE DESIGNATION	NAME OF MAJOR UNIT	SYMBOL GROUP	ASSEMBLY DRAWING NUMBER
1	CMD-66AFH	ANTENNA & DETECTOR	101 to 199	FA-1-WJ7
1	CMD-50ADC	AMPLIFIER	201 to 299	FA-2-WJ7
1	CMD-60ABG-1	TEST OSCILLATOR	301 to 399	FA-5-WJ7
1	CMD-10229	RACK	401 to 499	PA-702A
		ACCESSORIES	501 to 599	

TABLE IV
SPARE PARTS LIST BY NAVY TYPE DESIGNATION FOR
MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

QUANTITY		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFG.	MFR. DESIG.	MIDWEST PART NUMBER
EQUIP. SPARES	STOCK SPARES							
				MISCELLANEOUS (CLASS 10)				
2			A-101, A-102	Neoprene Gasket		1		4G2A
1	4		A-401, A-402, A-403 A-404	8 pound holder type rubber shock absorber		4	150PHS	7S1
2			E-101	Grid-Plate connector		2	4C91A	4C91A
1			E-102	Sliding indicator and tuning piston		2	PA10	PA10
2			E-107	Plate Connector		2	4C80	4C80
	4		E-201, E-202, E-203 E-204	Threaded polystyrene feed through bushing $\frac{1}{4}$-28 thread		12	TBP	4B3
2			E-205, E-206	Skirt knob, phenolic body with one white line as pointer, $1\frac{1}{2}$" dia. to fit $\frac{1}{4}$" shaft		13	S-380-64-B-BB-L	4K3-1
	4		E-301, E-302	Floating right angle nut, 8-32 thread, steel cadmium plated base, alum. alloy, anodized nut.		14	F8D32SA	4B4
1			E-303	Bar knob, brass pointer, N.P., phenolic body, to fit $\frac{1}{4}$" shaft		12	HRP-P	4K1
1			E-304	Radiator rod for test oscillator		2	PA128	PA128
	1		E-305	Radiator and pick up loop.		2	PA127A	PA127A
	1		E-306	Line Support		2	PA150	PA150
2			H-102, H-102	Tube socket spacer for short tube (-446)		2	4C81-1	4C81-1
2			H-107, H-108	Stud		16	99862-2-140	4F6
2			H-109, H-110	Cross pin		16	99785-2	4F14
2			H-111	Bracket and Receptacle		2	PA-16	PA-16
2			H-113, H-114	Mounting bar and nuts		2	PA17	PA17
	2		H-201, H-202	Eye bracket, steel, cadmium plated, 8-32 thread.		17	CTWS	4B5
	5		H-203, H-204, H-205 H-206, H-301	Tube hold down 1.3" inside clearance		18	8596	4H1
	1		H-207	Tube hold down VR type 1.203" clearance		18	8590	4H2
1	2		H-208	#10 Allen wrench		19	#10	4T21
1			H-209	Plug button to conceal shaft of control		18	51007	4B11
	4		H-302, H-303	Captive screw knurled head, black nickel plated 8-32 thread.		20	AM29-30	4S62
1	2		H-304	#8 Allen Wrench		19	#8	4T20
1			W-501	7½ ft. assembled cable				4W9A
				METERS (CLASS 22)				
	4	MR25W109SPEC	M-201	Milliameter D.C., single scale, calibrated in C.P.S. 0 to 8000, flush mounting type, phenolic case 1-5/32" behind flange 1 11/16 x 1 1/4-32 studs. full scale deflection 1 Ma. D.C., resistance 57.2 ohms		23	0X33	7M20-1
				SWITCHES (CLASS 24)				
1	2	-24001	S-201	Toggle switch, D.P.S.T., bat handle, 3 amp.125 volts	RE24AA118A	28	IGA2A21	4S4
1	1		S-301	Rotary type switch, double pole, 4 position, non-shorting contacts		29	24602-HIC	4S1

TABLE IV (Cont'd)

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
				FUSES (CLASS 28)				
10	50		F-201, F-202	Fuse, 2 amp. 250 volts, overall length 1¼" dia. ¼"		15	3AG-2	4F5
				TRANSFORMERS (CLASS 30)				
1	1		T-201	Pulse transformer, primary: 50 turns #35 SSE wire, secondary: 375 turns #35 SSE wire, core material: moly permalloy	RE13A554D	2	4T11	4T11
	2		T-202	Power transformer, primary 110V. A.C., 60 to 2400 cycles, secondary #1-480 volts with center tap to deliver .050 amperes rectified with 4 mfd. condenser input filter, secondary #2 - 6.3 volts at 3.5 amperes, secondary #3.5 volts at 2.0 amperes		24	8399	4T10-1
				VACUUM TUBES (CLASS 38)				
2		-446A	V-101	Vacuum tube, (receiving triode) glass, base #6527			GL-446-A	4U7
6		-6AC7	V-201, V-202, V-203	Vacuum tube (receiving pentode) metal, standard octal base, 6.3 volts at 0.45 amp.	JAN-1A	11	6AC7	4U5
4		-6SL7GT	V-204, V-302	Vacuum tube,(receiving-dual triode) glass, standard octal base, 6.3 volts at 0.3 amp.	JAN-1A	11	6SL7GT	4U6
4		-6SN7GT	V-205, V-206	Vacuum tube (receiving-dual triode) glass, standard octal base 6.3 volts at 0.6 amp.	JAN-1A	11	6SN6GT	4U9
2		-6E5	V-207	Vacuum tube, (receiving-triode with electron ray indicator) glass, small 6 pin base, 6.3 volts at 0.3 amp	JAN-1A	11	6E5	4U10
2		-VR150-30	V-208	Vacuum tube (Voltage regulator) glass, small shell octal, 6 pin base, 180 D.C. volts starting supply, operating voltage 150 DC, operating current 5ma. to 30 ma. D.C.	JAN-1A	11	VR150-30	4U12
2		-5Y3GT	V-209	Vacuum tube (full wave rectifier) glass, standard octal base, 5 volts at 2.0 amp.		11	5Y3GT	4U11
2		-955	V-301	Vacuum tube, glass, acorn type, 6.3 volts at 0.15 amp. 5 prong.	JAN-1A	11	955	4U1
				INDUCTORS-R.F. CHOKES (CLASS 47)				
	2		L-201	Reactor, 10 Henries at 50Ma. D.C., resistance approximately 325 ohms.		24	8439	7C31-1
1	2		L-301, L-302	R. F. choke, 5 turns #16 ga. silver plated copper wire 5/16" I.D., 10 turns per inch.		2	4C30	4C30

TABLE IV (Cont'd)

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
				CAPACITORS (CLASS 48)				
1		-481037-B20	C-101	Capacitor, mica, .005 mfd. ± 20% 500 V.D.C. working	RE48A143G	5	MWBW-1239	4C16
1	3	-48704	C-201	Capacitor, paper, oil filled, .5 mfd. 400 V.D.C. working	RE48A138H	6		4C18A
2	8	-48709A	C-202, C-205, C-208	Capacitor, paper, 3 sections, each section 0.1 mfd. 600 V.D.C. working	RE48A138H	7	2529-4	4C11
2	10		C-204, C-207, C-217 C-218	Capacitor, molded paper, .005 mfd. 600 V.D.C. working		8	Type DP	4C22
1	5	-48678	C-210, C-226	Capacitor, paper, two section, each section 0.1 mfd 400 V.D.C. working	RE48A128J	6		4C17A
1	5		C-211, C-212	Capacitor, ceramic, 50 mmfd. ± 5 mmfd, 500 V.D.C.		9	N750K-50±5	4C27
2	8	-481197-10	C-215, C-216, C-301	Capacitor, ceramic, 25 mmfd ± 2.5 mmfd 500 V.D.C.		9	N680K-25 ±2.5	4C2
1	3	-481002	C-219	Capacitor, paper, 0.5 mfd. 600 V.D.C. working	RE48A128J	6		4C26
1	5	-481623	C-220	Capacitor, ceramic, 7-45mmfd. variable, 500 V.D.C. .0005 mmfd./mmfd./°C temp. coeff.		9	N500TS2A	4C25
2	10	-481054	C-221, C-223, C-224 C-225	Capacitor, paper, 4 mfd. 600 V.D.C. working	RE48A207B	10	TLA6040	4C8
1	5		C-302, C-305	Capacitor, ceramic 100mmfd. ± 10% 500 V.D.C.		9	N750L-100 ±10	4C3
1	1	-48675-20 CM20A201M	C-303	Capacitor, mica 200mmfd. ±20% 500 V.D.C. working	RE48A148D	5	MO-1418	4C4A
1	1	-48691-20 CM20A501M	C-304	Capacitor, mica, 500mmfd. 20% 500 V.D.C. working	RE48A148D	5	MO-1422	4C5A
1	5		C-306	Capacitor, button mica, 500 mmfd. ±5% 500 V.D.C.		9	370A	4C23
1	1		C-307	Capacitor, mica, unmolded, 100 mmfd with foil leads		11	Style 80390	4C7
1	3	-481001	C-308	Capacitor, paper 0.1 mfd. 600 V.D.C.	RE48A128J	7	#2527-12	4C10
1	5		C-309	Capacitor, ceramic 55mmfd. 10% Temp-coeff, .0004 mmfd/°C 600 V.D.C. working		9	817	4C24
1	3		C-227	Capacitor, paper, .02 mfd., ± 30%, 15 V.D.C.W.		8	Type DP	4C28
				JACKS, PLUGS, & SOCKETS (CLASS 49)				
1		AN3102-12S-3S	J-101	2 circuit type AN connector (female)	AN9534	17	AN3102-12S 3S	4S30
1	1	-49194	J-102, J-201	1 circuit coaxial connector	RE49F167D	21	7130	4S100
	1	AN3102-14S -7P	J-202	3 circuit type AN connector (male)		17	AN3102-14S-7P	4S25
	1	AN3102-14S -9S	J-203	2 circuit type AN connector (female)		17	AN2102-14S -9S	4S26
	1		J-204, J-301	Socket, 4 circuit (female)		22	S304AB	4S12
	1		J-205	Telephone Jack, single circuit		22	JK34A-J300	4S18
2	2	-49195	P-501, P-505	1 circuit coaxial plug	RE49F167D	21	7131	4P14
1	2	AN3108-14S-9P	P-502	2 circuit AN plug (male) with clamp		17	AN3108-14 S-9P	4P22
1	2	AN3108-14S-7S	P-503	3 circuit AN plug (female) with clamp		17	AN3108-14S-7S	4P21

TABLE IV (Cont'd)

QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
				JACKS, PLUGS, & SOCKETS (Cont'd)				
1		AN3108-12S 13P	P-504	2 circuit AN plug (male)	AN9534	17	AN3108-12S-3P	4P10
2	2		P-506, P-507	Plug, 4 circuit (male)		22	P-304-CCT	4P1
1	1	NAF1136-1	P-508	2 circuit headphone plug			P-166	4P9
1	2		P-509, P-510	Right angle adapter for P-501		21		4P15
1			X-101	Vacuum tube socket, standard receiving octal, wafer type, ceramic base material	RE13A554D	18	#115001-6	4S9
	1	-49374	X-201, X-202, X-203 X-204, X-205, X-206 X-207, X-208, X-302	Vacuum tube socket, standard receiving octal, wafer type, phenolic base material	RE49AA312A	18	9864	4S11
	1	-49348	X-209	Vacuum tube socket, standard 6 prong, molded phenolic base, metal shield cap	RE49AA313A	17	PF6-7	4S19
	2		X-210, X-211	Fuse Holder, phenolic body, bayonet type to hold type 3AG fuse		15	HCM	4F10
1	2		X-301	Acorn type tube socket, wafer type, ceramic base		31	62-A5	4S10
				RESISTORS (CLASS 63)				
1	5		R-201	Pontentiometer, wire wound, 10000 ohms, 3 watt, linear taper type 2 shaft, 5/8" long, screw driver slot in shaft.	RE13A492C	25	S21-010-072	4R15A
2	10	-63360**	R-202, R-204, R-208 R-219	Resistor, composition, 10000ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R17
1	5	-63360**	R-205, R-209	Resistor, composition 27000 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R20
1	3	-63360**	R-203	Resistor, composition, 180 ohms, ±10%, ½watt, pigtail leads	RE13A340C	9	Type 504	4R18
2	10	-63360**	R-206, R-210, R-220	Resistor, composition, 27000 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R22
1	3	-63360**	R-207	Resistor, composition, 220 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R23
2	10	-63360**	R-211, R-214, R-239 R-240	Resistor, composition, 2200 ohm, ±10&, ½watt, pigtail lead	RE13A340C	9	Type 504	4R21
1	3	-63360**	R-212	Resistor, composition, 15000 ohms, ±10% ½watt, pigtail leads	RE13A340C	9	Type 504	4R33
1	3	-63360**	R-213	Resistor, composition, 33000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R49
1	3	-63360**	R-215	Resistor, composition 56000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R29
1	3	-63360**	R-216	Resistor composition, 47000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R30
1	5	-63360**	R-217, R-218	Resistor composition 56000 ohms 10% ½ watt, pigtail leads	RE13A340C	9	Type 504	4R28
3	5		R-222, R-225, R-235	Potentiometer, composition, 10000 ohms, linear taper shaft 3/4" long, screw driver slot in shaft.		26	Type J U1031CR	4R52

TABLE IV (Cont'd)

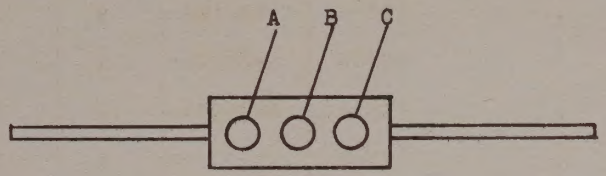
QUANTITY EQUIP. SPARES	QUANTITY STOCK SPARES	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED		NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	MIDWEST PART NUMBER
1	3	-63288**	R-223	Resistor, composition 69000 ohms 10% 1 watt, pigtail leads	RE13A340C	9	Type 518	4R55
1	3	-63360**	R-224	Resistor, composition 6800 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R38
1	8		R-226, R-307	Resistor composition 1.0 megohm, 20% ½ watt, pigtail leads. Replace by Navy-63360**	RE13A340C	9	Type 504	4R6
1	5	-63360**	R-227, R-233	Resistor, composition, 1500 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R48
1	5	-63360**	R-228, R-234	Resistor, composition 470,000 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R35
1	3	-63360**	R-244	Resistor Composition 20 megohm, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R53
1	5	-63360	R-230, R-304	Resistor, composition 3.3 megohm, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R4
1	5		R-231	Potentiometer, wire wound, 10000 ohms, 3 watt, linear taper, shaft 3/4" long	RE13A492C	27	P58-10000	4R51
1	3	-63360**	R-232	Resistor, composition 680000 ohms, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R54
1	3	-63288**	R-236	Resistor, composition, 22000 ohms 10% 1 watt pigtail leads	RE13A340C	9	Type 518	4R37
1	5	-631361	R-237	Potentiometer, wire wound, 75000 ohms, 3 watts, linear taper shaft 1" long	RE13A492C	27	P58-75000	4R12B
1	3	-63360**	R-238	Resistor, composition, 100000 ohms, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R39
1	3	-63360**	R-241	Resistor, composition 4700 ohms 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R40
1	3	-63360**	R-242	Resistor, composition 3300 ohms, 10% ½ watt pigtail leads	RE13A340C	9	Type 504	4R50
1	5		R-243	Resistor, wire wound, 4400 ohms, ±5%, 5watts, pigtail leads		7	5NI	4R56
1	3	-63360**	R-301	Resistor, composition, 15 megohm, ±10%, ½watt, pigtail leads	RE13A340C	9	Type 504	4R1
1	3	-63360**	R-303	Resistor, composition, 6.8megohm, ±10%, ½watt, pigtail leads	RE13A340C	9	Type 504	4R2
1	5		R-305, R-306	Resistor, composition, 8200 ohms, ±20%, ½watt, pigtail leads Replace by Navy -63360**	RE13A340C	9	Type 504	4R5
1	5		R-308, R-309	Resistor, composition, 22000ohms, ±20%, ½watt, pigtail leads Replace by Navy -63360**	RE-13A340C	9	Type 504	4R7
1	3		R-310	Resistor, composition, 1000ohms, ±20%, ½watt, pigtail leads Replace by Navy -63360**	RE13A340C	9	Type 504	4R8

** In ordering replacements by this type number it is necessary to state resistance value.

TABLE V
APPLICABLE COLOR CODES AND MISCELLANEOUS DATA FOR MODEL ARD- 2 AIRCRAFT RADIO RECEIVING EQUIPMENT

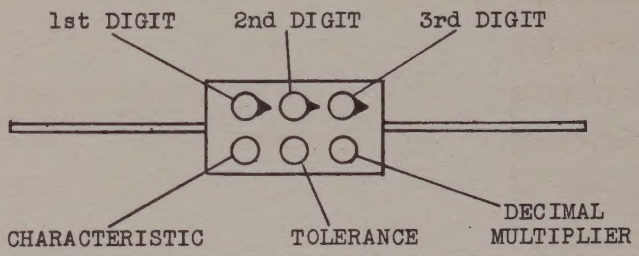
COLOR CODE IN MMFD. FOR CAPACITORS

	1st DIGIT	2nd DIGIT	CIPHERS
COLOR	A	B	C
BLACK	0	0	NONE
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
PURPLE	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000



AMERICAN WAR STANDARD COLOR CODE IN MMFD. FOR CAPACITORS

COLOR	1st DIGIT	2nd DIGIT	3rd DIGIT	DECIMAL MULTIPLIER	TOLERANCE	CHARACTERISTIC
BLACK	0	0	0	1		A
BROWN	1	1	1	10		B
RED	2	2	2	100	2%	C
ORANGE	3	3	3	1,000		D
YELLOW	4	4	4			E
GREEN	5	5	5			F
BLUE	6	6	6			G
VIOLET	7	7	7			
GRAY	8	8	8			
WHITE	9	9	9			
GOLD				0.1	5%	
SILVER				0.01	10%	
BLACK					20%	



COLOR CODE IN MMFD. FOR "TOOTHPICK" CAPACITORS

RED	100

STANDARD COLOR CODE IN OHMS FOR RESISTORS

	1st DIGIT	2nd DIGIT	CIPHERS
COLOR	A	B	C
BLACK	0	0	NONE
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
PURPLE	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000

TOLERANCE CODE D	%
BLACK or NONE	20
SILVER	10
GOLD	5

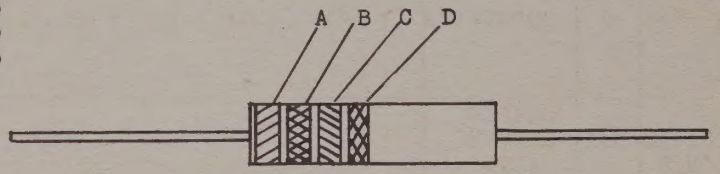


TABLE VI
LIST OF MANUFACTURERS
FOR MODEL ARD-2 AIRCRAFT RADIO RECEIVING EQUIPMENT

CODE NUMBER	MFR. PREFIX.	NAME	ADDRESS
1		TOLEDO INDUSTRIAL RUBBER CO.	532-8 ST. CLAIR, TOLEDO, OHIO
2	CMD	MIDWEST RADIO CORP.	909 BROADWAY, CINCINNATI, OHIO
3	CSH	H. B. SHERMAN	1934 SPERY ST., BATTLE CREEK, MICHIGAN
4		LORD MFG. CO.	ERIE, PENNSYLVANIA
5	CSL	SOLAR MFG. CORP.	588 AVENUE A, BAYONNE, NEW JERSEY
6	CAW	AEROVOX WIRELESS CORP.	742 BELLEVILLE AVENUE, NEW BEDFORD, MASS.
7	CSF	SPRAGUE SPECIALTIES CO.	N. ADAMS, MASS.
8	CTD	TOBE-DEUTSCHMANN CORP.	CANTON, MASS.
9	CER	ERIE RESISTOR CORP.	644 W. 12th ST., ERIE, PA.
10	CD	CORNELL-DUBILIER CORP.	1000 HAMILTON BLVD., SOUTH, PLAINFIELD, N.J.
11	CRV	R.C.A. MFG. CO.	POINT & COOPER STS., CAMDEN, NEW JERSEY
12	CNA	NATIONAL COMPANY, INC.	61 SHERMAN ST. MALDEN, MASS.
13		KURZ-KASCH INC.	1423 S. BROADWAY, DAYTON, OHIO
14		BOOTS AIRCRAFT NUT CORP.	NEW CANAAN, CONN.
15	CFA	BUSSMAN MFG. CO.	2538 W. UNIVERSITY ST., ST. LOUIS, MO.
16	CUF	UNITED CARR FASTENER CO.	450 MAIN ST., CAMBRIDGE, MASS.
17	CPH	AMERICAN PHENOLIC CORP.	1250 W. VAN BUREN ST., CHICAGO, ILL.
18	CMG	CINCH MFG. CO.	2339 W. VAN BUREN ST., CHICAGO, ILL.
19		MECHANICAL SUPPLY CO.	VINE & PEARL STS., CINCINNATI, OHIO
20	CTC	CHICAGO TELEPHONE SUPPLY CO.	ELKHART, INDIANA
21	CQA	THE ASTATIC CORP.	830 MARKET ST., YOUNGSTOWN, OHIO
22	CJC	HOWARD B. JONES	2300 W. WABANSIA AVENUE, CHICAGO, ILLINOIS
23	CAY	WESTINGHOUSE ELECTRIC & MFG. CO.	NEWARK WORKS, NEW JERSEY
24	CTR	CHICAGO TRANSFORMER CORP.	3501 ADDISON ST., CHICAGO, ILL.
25	CBN	CENTRAL RADIO LABORATORY	900 E. KEEFE AVENUE, MILWAUKEE, WIS.

TABLE VI (Con'd)

CODE NUMBER	MFR. PREFIX	NAME	ADDRESS
26	CBZ	ALLEN-BRADLEY CO.	118 W. GREENFIELD AVE., MILWAUKEE, WISC.
27	CMC	CLAROSTAT MFG. CO.	285-287 N. 6th ST., BROOKLYN, NEW YORK
28	CG	GENERAL ELECTRIC CO.	SCHNECTADY, NEW YORK
29	COC	OAK MFG. CO.	1200 N. CLYBOURNE AVE., CHICAGO, ILL.
30		ESSEX WIRE CORP.	14312 WOODWARD AVE., DETROIT, MICH.
31		THE FRIEDMAN CO.	220 E. 25th ST., NEW YORK CITY, NEW YORK
32		NATIONAL LOCK WASHER	38 HERMON ST., NEWARK, NEW JERSEY
33		MFG'S SCREW PRODUCTS	250 W. HUBBARD ST., CHICAGO, ILL.
34		GUARANTEE SPECIALTY MFG. CO.	60 LISPENARD ST., NEW YORK, NEW YORK
35		TUBULAR RIVET & STUD	WOLLASTON, MASS.
36		SHAKEPROOF LOCK WASHER	2501 N. KEELER AVE., CHICAGO, ILL.
37		ZIERICK MFG. CORP.	385 GERARD AVE., NEW YORK, NEW YORK
38		UNITED SCREW & BOLT CORP.	3592 W. 58th ST., CLEVELAND, OHIO
39		BLAKE & JOHNSON CO.	1300 THOMASTON AVE., WATERVILLE, CONN.
40		ELASTIC STOP NUT CORP.	2330 VAUXHALL RD., UNION, NEW JERSEY
41		PHELPS DODGE COPPER CORP.	40 WALL STREET, NEW YORK, NEW YORK

SPARE PARTS PRICE LIST

MIDWEST PART NO.	PRICE EACH	MIDWEST PART NO.	PRICE EACH	MIDWEST PART NO.	PRICE EACH	MIDWEST PART NO.	PRICE EACH	MIDWEST PART NO.	PRICE EACH	MIDWEST PART NO.	PRICE EACH
4B3	.04	4C30	.48	4P22	2.55	4R37	.03	4S25	.77	4U12	.97
4B4	.07	4C80	1.65	4R1	.03	4R38	.03	4S26	.62	4W9A	.38/ft
4B5	.03	4C81-1	.11	4R2	.03	4R39	.03	4S30	.93	PA10	4.30
4B11	.78	4C91A	.68	4R4	.03	4R40	.03	4S62	.09	PA16	2.15
4C2	.075	7C31-1	9.10	4R5	.03	4R48	.03	4S84	.06	PA17	.66
4C3	.075	4F5	.04	4R6	.03	4R49	.03	4S100	1.15	PA127	1.63
4C4	.075	4F6	.16	4R7	.03	4R50	.03	4S105	.06	PA128	2.64
4C5	.11	4F10	.30	4R8	.03	4R51	1.06	4S106	.06	PA150	1.87
4C7	.35	4F14	.015	4R12B	2.08	4R52	3.45	4S109	.06		
4C8	2.30	4G2-A	.11	4R15A	.84	4R53	.04	7S1	.53		
4C10	1.05	4H1	.07	4R17	.03	4R54	.04	4T20	.04		
4C11	1.52	4H2	.07	4R18	.03	4R55	.04	4T21	.04		
4C16	.32	4K1	.31	4R20	.03	4R56	.05	7T10-1	16.10		
4C17A	1.25	4K3-1	.40	4R21	.03	4S1	2.56	4T11	8.90		
4C18A	1.12	7M20-1	12.66	4R22	.03	4S4	.45	4U1	2.90		
4C22	.63	4P1	.16	4R23	.03	4S9	.19	4U5	.99		
4C23	.96	4P9	.55	4R28	.03	4S10	.65	4U6	.77		
4C24	.45	4P10	2.45	4R29	.03	4S11	.11	4U7	12.90		
4C25	.49	4P14	1.68	4R30	.03	4S12	.14	4U9	.66		
4C26	1.18	4P15	1.54	4R33	.03	4S18	.22	4U10	.61		
4C27	.73	4P21	2.55	4R35	.03	4S19	.12	4U11	.39		